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Scientific and Technical Aerospace Reports

Abstracts *September–December 1964*

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3. Scientific and technical articles prepared by employees of NASA and its contractors that appear in the learned and technical journals.

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National Aeronautics and Space Administration

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Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles. 2204

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Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State. **2241**

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Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads. 2427

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VOLUME 2 NUMBER 17

Scientific and Technical Aerospace Reports

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September 8, 1964

01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-24335* Denver Research Inst., Colo.
THE COMMERCIAL APPLICATION OF MISSILE/SPACE TECHNOLOGY, PARTS 1 AND 2
John G. Welles, Lloyd G. Marts, Robert H. Waterman, Jr., John S. Gilmore, and Robert Venuti Sep. 1963 262 p refs (Sponsored by NASA)
(NASA-CR-56719) OTS: $17.00

Transfers of technology from the nation's missile-space programs to the commercial sector of the economy are investigated by identifying instances of transfer and by attempting to provide some understanding of the transfer processes. The discussion is divided into the following areas: (1) technological transfer; (2) information flow; (3) identification and measurement; (4) time lag; (5) methodology; (6) examples of technological transfer; (7) diffusion of technological information; and (8) reasons for the transfer of missile-space technology. A summary of major findings and conclusions is included. P.V.E.

N64-24851 Radio Corp. of America, Camden, N.J.
SYSTEMS ENGINEERING AND SPACE TECHNOLOGY
[1964] 67 p refs Fourteen Tech. Papers by RCA Scientists and Engineers

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9. OVERSEAS COMMERCIAL COMMUNICATIONS SATELLITE SYSTEMS: 1965–1975 J. S. Greenberg, S. Gubin, and M. Handelsman p 44–48 (See N64-24859 17-08)
10. A HIGH-RESOLUTION RANGE COUNTER L. C. Drew p 49–51 refs (See N64-24860 17-09)
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12. EVOLUTION OF THE HIGHEST-PRECISION RADAR: THE STORY OF MIPIR J. W. Bornholdt and W. J. Rose p 56–60 refs (See N64-24862 17-08)
13. PLASMA-MICROWAVE INTERACTIONS J. Vollmer p 61–64 refs (See N64-24863 17-24)

N64-24852 Radio Corp. of America, Princeton, N.J.
SYSTEMS ENGINEERING: I. THE ROLE OF SYSTEMS ENGINEERING AT RCA
N. I. Korman *In* RCA, Camden, N.J. Systems Eng. and Space Technol. [1964] p 2–3 (See N64-24851 17-01)

This is a general survey of systems engineering and its role at RCA. G.D.B.

N64-25006* United Research, Inc., Cambridge, Mass.
FUTURE U.S. TRANSPORTATION NEEDS
H. H. Norling [1963] 302 p refs
(Contract NASw-585)
(NASA-CR-57005) OTS: $19.75 ph

This is a study of anticipated transportation needs in the United States for the next 25 years, and includes identification of factors and characteristics of transportation demands; demographic and economic forces in the U.S. through 1985; demands on intra rban transportation; domestic intercity passenger transportation; American travel abroad; and future trends in intercity freight demands. G.D.B.

N64-25095 Santa Barbara Research Center, Goleta, Calif.
PRODUCTION ENGINEERING MEASURE, PbSe INFRARED DETECTOR—TYPE IR-200 Fourth Quarterly Progress Report, 1 Oct. 1963–1 Jan. 1964
G. H. Cook 30 Apr. 1964 53 p
(Contract DA-36-039-AMC-01466(K))
(Rept.-5527-Q4; AD-439410)

Fabrication and calibration of the special test equipment have been completed. Fabrication of the preproduction units

has been initiated. Also, photographs of the special equipment are presented along with schematic drawings of circuits, not commercially available, which are part of the test equipment. These photographs are of (1) the temperature and humidity chamber; (2) the altitude and temperature chamber; (3) test consoles for detectivity, frequency response and noise spectrum, and for the zone plate spectrometer; (4) the optimum bias soaking rack; and (5) the IR test console for the cell responsivity contour. I.v.L.

N64-25182 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-Sous-Bagneux
NATIONAL OFFICE OF AEROSPACE RESEARCH
Jun. 1963 53 p refs

Aerodynamic, propulsion, and structural research are discussed. Aerodynamic research is centered on the airflow around fuselages, wings, and control surfaces of aircraft, and around various missile configurations during flight. It is also concerned with the thermal exchanges between that flow and the structure, flight mechanics, and control. Propulsion research is orientated toward rocket design and the characteristics of the various means of space propulsion. Structural research is directed toward acquiring the necessary knowledge to predict the behavior of aircraft and missiles under the influence of aerodynamic forces, thermal stresses, and control forces. The main object of this research is to eliminate vibrations that might endanger very light structures. I.v.L.

N64-25185 RAND Corp., Santa Monica, Calif.
A DISCUSSION OF SPACE PROGRAM COSTS
David Novick Feb. 1964 12 p Presented at the Princeton U. Conf., The Space Program: Costs and Payoff, 20 Feb. 1964
(P-2858)

Space program costs have been much higher in most cases than originally estimated. There are better techniques of estimating costs that are semantically more accurate and are therefore closer to reality. The complexities of space programs in view of all the variables and unforseeable events make cost figures subject to radical change. G.D.B.

N64-25431 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AUTOMATIC CONTROL OF AIRCRAFT ENGINES Selected Articles
3 Dec. 1963 141 p refs Transl. into ENGLISH of 7 Articles from Avtomat. Regulir. Aviadvigateley (Moscow), no. 4, 1962 p 5–69, 95–135
(FTD-TT-63-745/1+2+4; AD-430525)

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2. SIMULATION OF RANDOM DISTURBANCES OF A TURBULENT ATMOSPHERE T. S. Mart'yanova p 18–35 refs (See N64-25433 17-02)

3. THE OPERATION OF AN AIR-INTAKE AND ITS CONTROL SYSTEM IN A PERTURBED ATMOSPHERE V. I. Novikov p 36–75 refs (See N64-25434 17-04)

4. CERTAIN VERY SIMPLE TIMING REGULATORS ENSURING ACCELERATION OF A *TJE* WITH RESPECT TO REDUCED PARAMETERS Yu. V. Lyubomudrov p 76–84 (See N64-25435 17-27)

5. RELIABILITY AND INCREASE IN THE WORKING LIFE OF THE CONTROL AND FUEL-SUPPLY EQUIPMENT OF GAS-TURBINE ENGINES G. P. Anuchkin p 85–96 (See N64-25436 17-04)

6. INVESTIGATION OF THE CONTROL DYNAMICS OF A TURBOPROP ENGINE WITH A NEGATIVE-THRUST LIMITER L. N. Getsov and T. S. Mart'yanova p 97–113 (See N64-25437 17-27)

7. CERTAIN FEATURES OF PRESSURE JET ATOMIZERS OF A GAS-TURBINE ENGINE A. M. Prakhov p 114–137 refs (See N64-25438 17-27)

N64-25521 Argonne National Lab., Ill.
CHEMICAL ENGINEERING DIVISION RESEARCH HIGHLIGHTS, May 1963–April 1964
R. C. Vogel [1964] 193 p refs
(Contract W-31-109-ENG-38)
(ANL-6875) OTS: $2.75

The program consists of work in the following areas: (1) development of processes and equipment for the recovery of fissionable and fertile materials from spent nuclear fuels; (2) development of methods for the synthesis and production of nuclear reactor fuels and materials; (3) studies of methods for the direct conversion of heat into electricity; (4) studies of the chemical and physical behavior of nuclear reactor fuels and materials suitable for use at high temperatures; (5) basic studies of unit operations, heat transfer, and mass transfer in nonaqueous systems; (6) basic studies of the chemistry of substances that are of interest to nuclear technology, but which are also providing fundamental data of importance to the scientific community; (7) studies of chemical reactions that are important to the safe handling of nuclear fuels and the safe operation of nuclear reactors, and the correlation of laboratory-derived data with conditions existing in nuclear reactors; (8) determination of nuclear constants, particularly neutron cross sections of elements that are of importance to the design and performance of fast breeder reactors; and (9) analytical chemistry in support of the research and development programs. Author

N64-25649 RAND Corp., Santa Monica, Calif.
SPACE ARMS CONTROL: TRENDS, CONCEPTS, PROSPECTS
Alton Frye Feb. 1964 23 p
(P-2873; AD-438436)

A survey was conducted of recent developments, prospects, and concepts in the field of space arms control. Results are as follows: (1) Meaningful efforts at reliable space arms control can contribute to stabilizing the technological competition and to moderating the dangerous dynamics of the arms race. (2) Substantial investments in antisatellite capabilities may be necessary to enforce the ban against violators, even if suitable controls over space launches are established. (3) This country can encourage the Soviets to recognize that verification is an acceptable cost to their system by forthrightly convincing them that, in the absence of adequate verification procedures, the U.S. will undertake vigorous and extensive precautionary developments. (4) Detailed technical exploration between the two sides would be essential to devise a combination of procedures to supply an acceptable level of confidence that weapons of mass destruction are not being stationed in space. I.v.L.

N64-25677* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
31 May 1964 52 p ref
(Contract NAS7-100)
(NASA-CR-56727; JPL-SPS-37-27, Vol. 6) OTS: $5.60 ph

The following are discussed: (1) lunar program—Ranger Project and Surveyor Project; (2) planetary-interplanetary program—Mariner Project; (3) the Deep Space Network (DSN)—the Deep Space Instrumentation Facility, Space Flight Operations Facility, and DSN ground communication system; and (4) space sciences—space instrument systems and applied science. R.T.K.

N64-25739 Edison (Thomas A.) Industries, West Orange, N.J.
ENVIRONMENTAL INSTRUMENT PACKAGE FOR A CIVIL DEFENSE SHELTER Final Report
M. D. Bowers, J. Allstaedt, A. B. Gloor, N. S. Joy, N. Martin et al May 1964 202 p refs
(Contract OCD-05-62-216)
(AD-600759)

A study of instrumentation for monitoring the environment within a civil defense survival shelter was made. The study plan traced hazardous conditions from the origin of the offending gases and vapors through man's physiological tolerance and effect to the required degree of detection instrumentation. Listed are the contaminants and conditions that might be expected, the allowable maximum concentrations for a typical shelter period, and design ranges for suitable instruments. Detection methods available in commercial instrumentation are reviewed and analyzed within the framework of shelter requirements. Representative sample devices employing the most promising techniques were obtained for test. An overall evaluation based on accuracy, reliability, ease of operation, cost, adequacy of instruction material, and general suitability for shelter use is tabulated. A list of manufacturers, arranged by product, allows nonrestrictive selection of a source for any or all instrumentation requirements. Individual specifications are drawn for each of three sizes of shelter packages. Recommendations for new instruments and improvements to available devices are made. Author

N64-25818 Reactive Metals, Inc., Seymour, Conn.
[FABRICATION, EXTRUSION, AND FORMING OF URANIUM MARK V-B BILLETS] Quarterly Progress Summary, Jan.–Mar. 1964
D. R. Jefferson 3 Jun. 1964 61 p refs
(Contract AT(30-1)-1405)
(BRB-81)

In studying the fabrication, extrusion, and forming of uranium Mark V-B billets, several areas of research are being carried out. The extrusion conditions that can be employed to avoid excessive duplexing in the Mark V-B extrusion from 9-in. billets were established. In uranium fabrication development, an offsite test was concluded to demonstrate electrochemical drilling of uranium billets for extrusion. Basic scoping investigations were concerned with two things: (1) A basic heat treatment study was made on uranium billets for extrusion. Both the number of cycles and the time at each cycle were investigated. (2) Studies were performed on various types of lubricants. In the development of extrusion, piercing difficulties are being encountered in maintaining adequate dimensional control. P.V.E.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-24263 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETERMINING OPTIMUM GEOMETRIC PARAMETERS OF AVIATION CONSTRUCTION
I. I. Drakin 7 Feb. 1963 13 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Aviats. Tekh. (USSR), no. 1, 1962 p 66–74
(FTD-TT-62-1717/1; AD-299618)

Equations for the determination of optimum values of geometric parameters are developed for the general case, where initial flight weight, ballistic coefficient, fuel weight, aerodynamic drag, and useful load are considered. Two examples of their application are given: (1) optimum specific load per wing at given speed and flight altitude; and (2) optimum elongation of the nose section of the fuselage. D.S.G.

N64-24882 David Taylor Model Basin, Washington, D.C. Aerodynamics Lab.
WIND-TUNNEL INVESTIGATION OF THE EFFECTS OF THRUST, SHROUD LENGTH, AND SHROUD CAMBER ON THE STATIC STABILITY CHARACTERISTICS OF SHROUDED PROPELLERS
Arthur E. Johnson Apr. 1964 27 p
(DTMB-AERO-1073; AD-601989)

Wind-tunnel tests of a powered, shrouded propeller with several related shroud profiles were made in order to determine the effects of geometric variables and thrust coefficient upon the static stability characteristics. Profiles tested included uncambered shrouds with chord-to-diameter ratios varying between 0.35 and 0.72, and positively and negatively cambered shrouds with chord-to-diameter ratios of about 0.5. Author

N64-24912 National Research Council of Canada, Ottawa High Speed Aerodynamics Lab.
DYNAMIC ANALYSIS OF A NON-ROLLING BALLISTIC MISSILE RAPIDLY ASCENDING THROUGH THE ATMOSPHERE
L. H. Ohman Jan. 1964 29 p refs
(LR-392; NRC-7858)

An analysis of the dynamic behavior of a ballistic nonrolling missile rapidly ascending through the atmosphere was performed. Both the boosting and coasting phase were considered in plane motion. The three original governing equations under certain, yet realistic, conditions can be reduced to a single second-order differential equation in angle-of-incidence describing the dynamics of the missile. An explicit solution to this equation, which has varying coefficients, is available. Criteria giving conditions for divergence, damped oscillations, and tumbling are derived. A numerical method for solving the complete equations was developed. A comparison of the explicit and the numerical solutions for a particular case was made and showed good agreement. Author

N64-24920 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SHOCK AND VIBRATION IN SPACE ENVIRONMENT: AN ANNOTATED BIBLIOGRAPHY
Charles G. Gros, comp. Apr. 1963 56 p refs
(Contract AF 04(647)-787)
(SB-63-24; Rept.-3-35-63-3; AD-401579)

This work treats of shock and vibration, in combination with each other and/or with other space environmental parameters. The period covered, with a few earlier exceptions, is from 1960 through 1962. Personal author, corporate author, and subject indexes are included. Author

N64-24932 Polytechnic Inst. of Brooklyn, Freeport, N.Y.
TRANSPIRATION COOLING OF A TURBULENT BOUNDARY LAYER IN AN AXISYMMETRIC NOZZLE
Joseph Librizzi and Robert J. Cresci Wright-Patterson AFB, Ohio, ARL, Jun. 1963 158 p refs
(Contract AF 33(616)-7661)
(ARL-63-103; AD-415448)

This report presents the results of an experimental investigation of the downstream influence of mass injection on the heat transfer to the surface of an axisymmetric nozzle in turbulent flow. Helium and nitrogen are used as coolants and are injected through a porous region upstream of the nozzle throat at various rates. The experimental heat tranfer is presented in terms of an appropriate similarity parameter as a function of coolant injection for various stations along the nozzle surface. Also presented is an approximate analysis for the prediction of the variation of heat transfer with coolant injection rate to the impermeable surface. The results of the experiments show a decrease in heat transfer with increasing mass injection, helium being more effective for the same mass flow rate than nitrogen. This decrease in heat transfer becomes less prominent as the distance downstream of the porous region increases. Author

N64-25017* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TABLES FOR SUPERSONIC FLOW AROUND RIGHT CIRCULAR CONES AT SMALL ANGLE OF ATTACK
Joseph L. Sims Washington, NASA, 1964 427 p refs
(NASA-SP-3007) GPO: $2.25

The report presents, in tabular form, the results of the calculation of supersonic flow fields about right circular cones at small angles-of-attack. The calculations were performed using the theory of Stone, which yields results in a wind-fixed coordinate system. However, all results presented herein have been transformed into a body-fixed coordinate system. Results are presented for cone angles from 2.5° to 30° in regular increments of 2.5°. For each of these 12 cone angles, a series of 16 problems was computed at free-stream Mach numbers from 1.5 to 20.0. The free-stream Mach number was not increased in even increments, but the same values were used for each cone angle. Author

N64-25046 Aeronautical Research Council (Gt. Brit.)
SIDE FORCE ON A WING BODY COMBINATION DUE TO TRAILING VORTICES
J. R. Barnes London, HMSO, 1964 11 p refs
(ARC-CP-669; Supersedes RAE-TN-AERO-2834, ARC-24221) HMSO: 3s 6d

A long cylindrical body has two wings attached symmetrically but set at equal and opposite angles relative to its axis. When this system is placed at incidence in a uniform flow a side force is experienced. The purpose of this note is to make some estimate of the magnitude of this side force. The vortices shed by the wings are assumed to have rolled up at the trailing edge, and their paths are calculated using slender body theory. Expressions are given for the forces experienced by the body aft of the wings, and some numerical calculations made. Author

N64-25074 Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF THE VELOCITY DISTRIBUTION DUE TO THICKNESS FOR SWEPT WINGS WITH SUBSONIC EDGES AT SUPERSONIC SPEEDS
A. B. Haines, R. Rollins, and J. Osborn London, HMSO, 1964 55 p refs
(ARC-CP-654; Supersedes ARA-43, ARC-23976) HMSO: 10s

This note describes a method for calculating according to linearized theory, the velocities produced by the thickness form of a sweptback wing having subsonic leading and trailing edges at supersonic Mach numbers. The method was programed for the Zebra computer and can cope with wings of arbitrary planform having arbitrary variation of both thickness/chord ratio and section shape across the span. At present, the method will only deal with wings having sharp leading edges. It is likely, however, that for round-nosed sections, if the true section is replaced by an equivalent sharp-nosed section, reliable results may still be obtained, at least aft of about 0.04c. Calculations were made for the velocities due to thickness at M = 1.2 over four different wings—untapered, tapered in plan, tapered both in plan and thickness/chord ratio, and tapered with a spanwise variation in section shape. The results for the fourth wing show that the changes in velocity produced by changes in thickness shape near the root are qualitatively similar at supersonic and at subsonic speeds. In certain applications, changes in section shape could be used to reduce the required amount of body waisting, whereas allowing the section shape to vary spanwise should give an added freedom in designing a suitable body shape to meet the requirements of the isobar patterns over both the upper and lower surface. Author

N64-25080 Therm. Inc., Ithaca, N.Y.
THE AERODYNAMIC LOADING ON STREAMLINED DUCTED BODIES
Gary R. Hough Dec. 1962 97 p refs
(Contract Nonr-2859(00))
(TAR-TR-625; AD-407148)

A simple method for the rapid determination of the linearized surface-pressure distribution on streamlined ducted bodies in axisymmetric flow is developed using conventional singularity distributions. The final form of the pressure coefficient is expressed directly as a single matrix operation on the duct sectional properties, and tables of the necessary matrix coefficients are given. Several numerical examples are worked out and compared with the results of previous theoretical and experimental investigations. Author

N64-25176 Aeronautical Research Council (Gt. Brit.)
A CORRELATION OF THE FOREBODY DRAG OF CYLINDERS WITH PLANE AND HEMISPHERICAL NOSES AT MACH NUMBERS FROM ZERO TO 2.5
A. Stanbrook London, HMSO, 1964 12 p refs
(ARC-CP-709; Supersedes RAE-TM-AERO-2875; ARC-24854) HMSO: 2s 9d

Drag at zero lift obtained on some simple shapes during experimental studies of the aerodynamic characteristics of various airborne stores is compared with results from other sources. Reasonable agreement is found between the measured drag, corrected for the effects of skin friction on the cylindrical surface, and integrated pressure distributions. The measured variation of forebody drag is found to agree well with modified forms of the prediction of Maccoll and Codd in the case of plane-nosed cylinders and an expression derived by Hoerner in the case of hemispherically-nosed cylinders. Author

N64-25360* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
DEFINITIVE INTERFERENCE-FREE EXPERIMENTAL STUDIES OF VEHICLE MOTION
Bain Dayman, Jr. N.Y., AIAA [1964] 16 p refs Presented at the 1st AIAA Ann. Meeting, Washington, 29 Jun. – 2 Jul. 1964
(Contract NAS7-100)
(AIAA Paper-64-476) AIAA: $0.50 members, $1.00 nonmembers

In the field of atmospheric flight mechanics, studies were based mainly upon theoretical considerations with unduly small experimental substantiation. This approach was dictated by the prohibitive nature of flight data and the small amount of realistic-motion ground-based (testing of unsupported models) data. Ballistic ranges, which have supplied the major portion of ground facility "flight" data, may yield increments of model motion larger than desired and definition of model orientation sometimes inadequately. Because of high model acceleration and velocity, the versatility of range tests is limited. Free-flight testing in conventional wind tunnels, a complementary technique, can provide a good portion of the necessary experimental data upon which to base and/or verify theoretical approaches, and such testing includes the simplification of ideal-gas flow. Trajectories across the viewing region may be obtained by releasing models from a transverse wire or by launching them upstream with a pneumatic gun. In either case, maximum acceleration is below 100 g's. This paper illustrates many types of information that can be obtained using this technique, such as high amplitude and frequency dynamic stability, base and wake properties, model separation and tandem motion studies, and various comparison data to determine degree of support interference. Author

N64-25433 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SIMULATION OF RANDOM DISTURBANCES OF A TURBULENT ATMOSPHERE

T. S. Mart'yanova *In its* Autom. Control of Aircraft Eng. 3 Dec. 1963 p 18–35 refs (See N64-25431 17-01)

Disturbances from moving masses of air (wind, air currents, gusts, turbulent formations in the atmosphere) are among the main disturbances affecting an aircraft and its powerplant and control systems during flight. This report deals with a method for simulating random atmospheric disturbances. The method of calculating the time characteristics of such disturbances, from the known statistical characteristics of the disturbances, and the method of simulating the time characteristics of such disturbances are examined. This simulation method readily permits variations of the parameters of the statistical characteristics of the disturbances—the average duration of the gusts and the mean square intensity of the gusts. I.v.L.

N64-25454 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INVESTIGATION OF ANNULAR DIFFUSORS OF MARINE-GAS-TURBINE INSTALLATIONS

S. F. Abramovich and L. G. Vasil'yev 3 Dec. 1963 15 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 3, 1963 p 34–38

(FTD-TT-63-1039/1+2; AD-428638)

This report discusses the factors affecting the efficiency, the coefficient of resistance, and the coefficient of restoration of the static pressure of symmetrical and asymmetrical annular diffusors with cylindrical and conical inserts. In these diffusors, there was free escape for the flow, which comes out onto a screen. Information was gained that can prove to be very useful in the designing of marine gas-turbine units. I.v.L.

N64-25674 Pennsylvania State U., University Park Ordnance Research Lab.

THE FLOW AND INTERFERENCE EFFECTS OF A BODY OF REVOLUTION AND ITS STABILIZING SURFACES WHEN AT AN ANGLE OF ATTACK

E. J. Rodgers 31 Mar. 1964 57 p refs

(Contract NOw-63-0209-c)

(TM-510-2481-03; AD-437239)

The flow over a body of revolution and its stabilizing surfaces, at an angle-of-attack, was studied in order to obtain a better understanding of the real flow effects, as well as the interference effects between components of the configuration. The velocity field about the configuration, the surface flow, and the pressure distribution were obtained with the model mounted in a wind tunnel. Analysis of the data showed there is an increase in lift on the body and a decrease in lift on the stabilizing surfaces from that of the isolated components at the same incidence to the flow. The interference effects between components is evidenced by the surface flows and pressure distribution, as well as by the vorticity distribution calculated from the measured velocity field. The decreased lift on the stabilizing surfaces is clearly related to the flow over the aft part of the body. Author

N64-25711* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A PARAMETRIC STUDY OF HYPERSONIC FLOW FIELDS ABOUT BLUNT-NOSED CYLINDERS AT ZERO ANGLE OF ATTACK

James E. Terry and Carlton S. James Washington, NASA, Jul. 1964 58 p refs

(NASA-TN-D-2342) OTS: $1.50

A systematic study has been made of the effects of changes in Mach number, altitude, nose-drag coefficient, and nose shape on the flow fields over the afterbodies of blunt-nosed cylinders traveling at hypersonic speeds. Shock-wave profiles for 3 families of nose shapes were measured at Mach 5, 10, and 15 and at various stream densities. The flow fields behind these shocks were obtained by stream-tube calculations. It was shown that the shock-wave shape and hence the surface-pressure distribution could not be predicted quantitatively by the blast-wave theory. The rate of decay of surface pressure with x/d was different in equilibrium air from that in a perfect gas. Surface-pressure ratios and shock-wave shape were insensitive to changes in altitude. Temperature, density, and, to a lesser extent, dynamic-pressure ratios vary appreciably with altitude. The thickness of the high-entropy layer near the body increases with both Mach number and drag coefficient. Author

N64-25714* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL INVESTIGATION OF BOUNDARY-LAYER CONTROL BY BLOWING ON AN NACA 65_5-424 AIRFOIL TO EFFECT DRAG REDUCTION

Thomas R. Turner Washington, NASA, Jul. 1964 30 p refs

(NASA-TN-D-2374) OTS: $0.75

An investigation was made to determine the effectiveness of boundary-layer control by blowing in reducing the drag of a two-dimensional airfoil with NACA 65_5-424 sections with the blowing slot located at 0.65 chord. The airfoil was equipped with a 0.35-chord blowing flap. Momentum coefficients ranged from 0 to 0.0233 for the basic airfoil (flap undeflected) and from 0 to 0.0501 with flap deflected. The flap was deflected from 0° to 30°. The Reynolds number for the investigation was 2.96×10^6. Results of the investigation showed that at low lift and momentum coefficients the drag is slightly reduced by blowing and at higher lift coefficients it is greatly reduced by blowing. A blowing momentum coefficient of 0.0107 caused the maximum lift–drag ratio to increase from approximately 20 to 35. These drag reductions are of the same order of magnitude as those for a suction slot at the same location. The increase in maximum section lift coefficients for the basic wing was as great or greater than that for the wing with a suction slot at the same chordwise station. A maximum section lift coefficient of 4.0 was obtained with a flap deflection of 30° and a momentum coefficient of 0.05. Author

N64-25809* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL CALCULATION OF SUPERSONIC FLOWS OF A PERFECT GAS OVER BODIES OF REVOLUTION AT SMALL ANGLES OF YAW
John V. Rakich Washington, NASA, Jul. 1964 58 p refs
(NASA-TN-D-2390) OTS: $1.50

A linearized characteristics method is used to obtain the first-order effects of yaw in the supersonic portion of the flow over bodies of revolution. The first-order perturbation equations are derived in terms of pressure and flow-deflection angles as dependent variables and are incorporated into an existing method of a characteristics computer program for axisymmetric flow. Some example flows obtained from the resulting program are presented for the purpose of establishing the accuracy and applicability of the method. The method yields results that are in agreement with Kopal's exact solutions for cone flow, and surface pressures for blunt-nosed cones tend to the pointed cone values at a large distance from the nose. The first-order perturbation field for a sphere-cone is compared with published results obtained by basically the same method; there is a general agreement of the results, but some differences are noted. Author

N64-25812* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL ANALYSIS OF FLOW PROPERTIES ABOUT BLUNT BODIES MOVING AT SUPERSONIC SPEEDS IN AN EQUILIBRIUM GAS
Harvard Lomax and Mamoru Inouye Washington, NASA, Jul. 1964 82 p refs
(NASA-TR-R-204) OTS: $2.25

An inverse method is presented for the numerical calculation of the flow field behind the bow shock wave of a blunt-nosed body traveling at hypersonic speeds. Numerical difficulties encountered with the inverse method are categorized and discussed. Examples of instabilities introduced by particular combinations of analytical and numerical methods are presented. Certain techniques for suppressing some of these instabilities are illustrated. A one-parameter family of shock-wave shapes yielded spherical-nosed, axisymmetric bodies to a high degree of accuracy. Solutions were obtained for perfect gases over a Mach number range from 5 to 100 for specific heat ratios from 1.1 to 1.6667 and for air in thermodynamic equilibrium over a speed range from 10,000 to 45,000 ft/sec for altitudes from 100,000 to 300,000 ft. Results for the shock-wave shape and standoff distance are presented for all the solutions, and comparisons with other methods are made. For the real air results, tabulations are presented for the body data and shock-wave and sonic line coordinates. Some results for ellipsoids and paraboloids are also shown. Author

N64-25822 Northrop Corp., Hawthorne, Calif. Norair Div.
LAMINAR FLOW CONTROL DEMONSTRATION PROGRAM Final Report
R. E. Kosin Apr. 1964 391 p ref
(Contract AF 33(600)-42052)
(NOR-61-141; AD-439815)

Aerodynamic and propulsion data and structure and stress data are the two categories in this design data report for the Norair X-21A Laminar Flow Control (LFC) Aircraft. The objectives of this program were to demonstrate the technical feasibility and operational capability of laminar flow control on a full-scale flight vehicle. The modification of the WB-66 involved removal of the wings and replacing them with laminar flow control wings. The propulsion engines were replaced by pylon-mounted YJ79-GE-13 engines on the aft fuselage. LFC suction compressors in pods were mounted under the wing. The fuselage was modified by the wing and engine replacement. The engineering development of the X-21A required the integration of the technologies used in the design of high subsonic aircraft with laminar flow technologies. G.D.B.

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-24397 Lockheed-California Co., Burbank
DEVELOPMENT OF A POWER SPECTRAL GUST DESIGN PROCEDURE FOR CIVIL AIRCRAFT Monthly Progress Report No. 3, May 1–31, 1964
F. M. Hoblit and N. Paul 5 Jun. 1964 63 p refs
(Contract FA-WA-4768)

Work accomplished in the development of a power-spectral gust-design procedure for civil aircraft is reported in the following areas: model of the atmosphere, mission profile data, collection of input data for analysis, and preliminary formulation of design-envelope and mission-analysis criteria. Lockheed is conducting the data program for its 749 and Electra aircraft, and Boeing has a data program for its 720 aircraft. M.P.G.

N64-24589* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LOW-SPEED LONGITUDINAL AERODYNAMIC INVESTIGATION OF PARAWINGS AS AUXILIARY LIFTING DEVICES FOR A SUPERSONIC AIRPLANE CONFIGURATION
W. Pelham Phillips Washington, NASA, Jul. 1964 57 p refs
(NASA-TN-D-2346) OTS: $1.50

A wind-tunnel investigation has been conducted to determine the improvement in low-speed aerodynamic performance characteristics that might be realized by the use of high-performance parawings as auxiliary lifting surfaces for overloaded supersonic airplanes. Included in the investigation were the effects of parawing orientation with respect to the airplane on the longitudinal trim characteristics in overloaded cruise conditions (at moderate lift coefficients). Studies of the effects of varying parawing incidence angle and vertical position relative to the airplane indicated that the addition of auxiliary parawings can produce maximum lift-drag ratios similar in magnitude to that of the airplane-alone configuration and at lift coefficients nearly three times as large. Author

N64-24818* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF LEADING-EDGE SWEEP ON FLUTTER CHARACTERISTICS OF SOME DELTA-PLANFORM SURFACES AT A MACH NUMBER OF 15.4
Robert C. Goetz Washington, NASA, Jul. 1964 38 p refs
(NASA-TN-D-2360) OTS: $1.00

A wind-tunnel investigation was conducted in helium flow at Mach 15.4 to determine some effects of leading-edge sweep and profile shape on the flutter characteristics of some

delta-planform all-movable control surfaces. The profile shapes tested were blunt leading-edge wedges, double wedges, and slabs. In general, the results indicate that increasing the leading-edge-sweep angle from 60° to about 65° or 70° is destabilizing, while further increases in sweep are stabilizing. However, these trends may be influenced by the layer of disturbed flow along the reflection plane surface, particularly for the more highly swept models. For each sweep angle the blunt double-wedge airfoils are the most susceptible to flutter, and the slab airfoils are the least susceptible to flutter. Results of flutter calculations made by using modified Newtonian theory and by piston theory aerodynamics in conjunction with an uncoupled two-mode strip analysis are compared with the experimental results. For all cases the Newtonian theory more closely predicted the experimental flutter speeds, particularly for the airfoils with large leading-edge radii. Author

N64-24822* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A REVIEW OF THE STALL CHARACTERISTICS OF SWEPT WINGS
Charles W. Harper and Ralph L. Maki Washington, NASA, Jul. 1964 47 p refs
(NASA-TN-D-2373) OTS: $1.25

The unsatisfactory situation regarding the understanding of the stall of swept wings complicates the design of new aircraft. A general hypothesis is presented that serves as a useful guide in determining what must be done empirically to achieve a given set of wing characteristics. Many general and specific studies made to control the stalling of swept wings support the hypothesis; however, it has not been possible to predict quantitatively the wing characteristics. Author

N64-24850 David Taylor Model Basin, Washington, D.C. Hydromechanics Lab.
EXPERIMENTAL PERFORMANCE OF *TMB* SUPERCAVITATING PROPELLERS
Richard Hecker, J. G. Peck, and W. A. Mc Donald Jan. 1964 183 p refs
(DTMB-432; AD-600361)

In order to evaluate the TMB design method for supercavitating (SC) propellers, and the validity of the theoretically calculated supercavitating design charts, several supercavitating propellers were built and tested in the TMB 24-in. water tunnel. The test results are given in this report. Comparisons between the predicted performance and the test results showed that the predictions are adequate enough to warrant the use of the TMB supercavitating series charts. Author

N64-24924 Aeronautical Research Council (Gt. Brit.)
FREE-FLIGHT MEASUREMENTS OF THE ZERO-LIFT DRAG OF A SLENDER OGEE WING AT TRANSONIC AND SUPERSONIC SPEEDS
J. B. W. Edwards London, HMSO, 1964 14 p refs
(ARC-CP-670; Supersedes RAE-AERO-2851, ARC-24448)
HMSO: 3s 6d

The zero-lift drag of a slender-wing model has been measured using the free-flight technique, and the wing wave drag has been deducted by subtracting the non-wave-drag components. The results are presented without correction for the drag increment caused by the transition strip and show a smooth variation of the wave drag factor K_0 with Mach number with a maximum occurring near M = 1.1. The overall level of K_0 is some 10% higher than that predicted by linear theory, but this result is very dependent on the accuracy of the skin-friction estimates as well as on the transition strip drag increment. Attempts to estimate the latter suggest that 4% of the total drag may arise from this source, which would reduce K_0 by some 12%, bringing it well in line with theory. Author

N64-24926 Aeronautical Research Council (Gt. Brit.)
MEASUREMENT OF LIFT AND PITCHING MOMENT ON FOUR OGEE WINGS AT SUPERSONIC SPEEDS Current Paper
L. C. Squire London, HMSO, 1964 23 p refs
(ARC-CP-673; Supersedes RAE-AERO-2841; ARC-24570)
HMSO: 4s 6d

Measurements have been made of the lift and pitching moments of one plane and three cambered slender ogee wings ($p = 0.45$; $S_T/c_0 = 0.208$) at four supersonic Mach numbers up to 2.0. The plane wing and one of the cambered wings are smaller scale versions of models tested previously, and provide a link between tests in the 3- × 3-ft and 8- × 8-ft wind tunnels at R.A.E. Bedford. The agreement between the two sets of results is very good. The other two models incorporate modifications to the original camber design, and the effects of these are discussed. Author

N64-25051* Consultants and Designers, Inc., Arlington, Va.
HYPERSONIC FLOW PAST AIRFOILS AT GREAT ANGLES OF ATTACK
G. G. Chernyy 11 May 1964 8 p refs Transl. into ENGLISH from Doklady Akademii Nauk SSSR (Moscow or Leningrad), v. 155, no. 2, 1964 p 302-305
(Contract NAS5-2078)
(NASA-TT-F-8696; ST-AGD-10139)

When hypersonic flow past airfoils occurs at great angles-of-attack, the compressed gas layer between the shock wave and the windward surface of the airfoil is relatively thin. To describe the gas glow in this layer, in studying certain peculiarities of flow past airfoils, the integral correlation method can be applied in its simplest form. It must be considered that in a compressed layer the gas velocity components in planes tangent to an element of airfoil, the pressure, and the density are constant along the normal of the airfoil, and that the normal velocity component to the airfoil may be neglected. This paper is limited to considering plane airfoils. G.D.B.

N64-25175 Aeronautical Research Council (Gt. Brit.)
THE ESTIMATION OF OSCILLATORY WING AND CONTROL DERIVATIVES
W. E. A. Acum and H. C. Garner (Aerodyn. Div., N. P. L.) London, HMSO, 1964 40 p refs
(ARC-CP-623; Supersedes NPL-AERO-423; ARC-22760)
HMSO: 7s 6d

The equations arising in the lifting-surface theory of oscillating wings are reviewed briefly. The accuracy with which the theory can predict the derivatives for wings and controls oscillating in simple modes is discussed and illustrated by reference to recent experimental work at between Mach 0 and 2.5. For wings of moderate aspect ratio the agreement between theory and experiment is good in purely subsonic flow. In the upper subsonic speed range the differences between calculated and measured pitching derivatives show signs of systematic variation even when they are not small. For slender wings at small mean incidence theoretical predictions agree surprisingly well with the few experimental data available; these show significant increases in pitching damping as mean incidence is increased. In supersonic flow the accuracy of linearized theory is well supported by experiment; nevertheless the comparison can be greatly improved, if thickness effects are included. In the transonic flow regime, theory and experiments agree only inasmuch as they follow the same trend with Mach number. Frequency effect becomes especially important, yet hard to

correlate and predict. The best hope appears to lie in a semi-empirical method based on linearized theory; proposed theoretical work on transonic derivatives is outlined. The large effects of slotted walls on derivatives measured in wind tunnels are discussed. This is an outstanding problem of the greatest importance, since it is essential to have reliable experimental values in the transonic speed range. Author

N64-25201 Aeronautical Research Council (Gt. Brit.)
AN EQUIVALENCE LAW RELATING THREE- AND TWO-DIMENSIONAL PRESSURE DISTRIBUTIONS
R. C. Lock London, HMSO, 1964 15 p refs
(ARC-R&M-3346; Supersedes NPL-AERO-1028; ARC-23952)
HMSO: 5s 6d

Two wings may be said to have equivalent pressure distributions if the distribution of M_n, the component of surface Mach number normal to the local isobars, is the same in both cases. A simple approximate method is given of calculating M_n from a knowledge of the pressure distribution, and some satisfactory comparisons with a more accurate theory are obtained. It is then possible to define an equivalent two-dimensional pressure distribution from a knowledge of the three-dimensional distribution, or vice versa. Author

N64-25245 Aerospace Corp., San Bernardino, Calif. Fluid Mechanics Dept.
AIR IONIZATION IN THE HYPERSONIC LAMINAR WAKE OF SHARP CONES
F. L. Fernandez and E. S. Levinsky 10 Jun. 1964 16 p refs
(Contract AF 04(695)-269)
(BSD-TDR-64-81; TDR-269(54811-20)-1; AD-602162)

A simplified analysis is proposed for determining peak ionization in the hypersonic laminar wake of slender cones, and the results are compared with more exact theories. Scaling laws for the effect of body size, shape, and altitude on laminar wake electron production are given. Comparisons with boundary-layer electron production rates are made for the case where peak wake and boundary-layer enthalpies are equal and where binary scaling is found to hold in the laminar wake. Author

N64-25382 Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
THE FORCE, MOMENT, AND HINGE-MOMENT CHARACTERISTICS OF SURFACE-PIERCING DIHEDRAL HYDROFOILS
R. P. Bernicker and P. W. Brown May 1964 39 p
(Contract Nonr-263(43))
(Rept.-964; AD-601578)

This report presents the results of an experimental and theoretical study of the forces acting on a fully wetted, surface-piercing dihedral hydrofoil, fitted with trailing-edge hinged flaps. The tests cover a range of dihedral, flap deflection, and trim angles at several depths of submergence. Measurements include lift, drag, pitching moment about the midchord point at the foil apex, and the flap hinge moment. The three-dimensional lift data are reduced to equivalent sectional values with appropriates aspect ratio and depth correction factors, and show good agreement with theoretical predictions for all aspect ratios and dihedrals tested. Author

N64-25384 Rocketdyne, Canoga Park, Calif.
SELF-COOLED ROCKET NOZZLES, VOLUME 2 Summary Report, 1 Jul. 1962–30 Jun. 1963
F. B. Gessner, R. J. Ingram, and J. D. Seader Mar. 1964 119 p refs
(Contract AF 33(657)-9166)
(R-5323; RTD-TDR-63-4046, Vol. 2; AD-601574)

A detailed analytical heat transfer model was developed for a self-cooled composite nozzle throat insert material. The analysis was programed for the IBM 7094 digital computer, and case studies were run for a number of coolants in a tungsten matrix. A fundamental understanding of the self-cooling phenomenon was gained, and the important coolant and matrix variables affecting cooling performance were determined. The capability of self-cooling to improve rocket nozzle performance was demonstrated. The most effective self-cooling effect was described as interface cooling, which was strongly influenced by the porous microstructure of the matrix and the coolant boiling point. Author

N64-25470 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON CALCULATION OF MOMENT COEFFICIENTS OF SELF-DAMPING AND EFFECTIVENESS OF AIR STEERING RUDDERS OF "FLYING PLATFORM" ON HOVERING REGIME
Ye. A. Kuklev 21 May 1964 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Aviats. Tekhn. (USSR), No. 4, 1962 p 12–17
(FTD-MT-63-287; AD-402444)

Control of ducted-fan helicopters of the flying platform type is carried out in most cases by air vanes. Both a proper margin of stability and a definite speed of attentuation of perturbed motions are assured during self-damping calculations. Simple formulas are presented for air vane and self-damping effectiveness of these helicopters while hovering. G.D.B.

N64-25495 Aeronautical Research Council (Gt. Brit.)
OSCILLATORY-DERIVATIVE MEASUREMENTS ON STING-MOUNTED WIND-TUNNEL MODELS: METHOD OF TEST AND RESULTS FOR PITCH AND YAW ON A CAMBERED OGEE WING AT MACH NUMBERS UP TO 2.6
J. S. Thompson London, HMSO, 1964 54p refs
(ARC-R&M-3355; Supersedes RAE-AERO-2668, ARC-24149)
HMSO: £1 1s

This report describes a method that was developed for an 8- by 8-ft supersonic tunnel. Direct and cross derivatives measuring oscillatory derivatives on sting-mounted models with respect to angular displacements and velocities in pitch and yaw have been measured satisfactorily, and results are given of tests on a cambered ogee wing at six Mach numbers from 0.2 to 2.6. Some tests were made on this model in the course of the preliminary development work in a 13- by 9-ft low-speed wind tunnel, and results of these are included. Author

N64-25604* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AFTERBODY PRESSURES ON TWO-DIMENSIONAL BOATTAILED BODIES HAVING TURBULENT BOUNDARY LAYERS AT MACH 5.98
W. Frank Staylor and Theodore J. Goldberg Washington, NASA, Jul. 1964 38 p refs
(NASA-TN-D-2350) OTS: $1.00

An investigation has been conducted on a series of two-dimensional afterbodies to determine the effects of boattailing and angle-of-attack upon base and boattail pressures. Afterbodies with boattail angles from 0° to 18° at angles-of-attack up to 14° were investigated at a free-stream Reynolds

number sufficient to cause fully turbulent boundary layers to exist ahead of the afterbodies. The models were tested at a free-stream Mach number of 5.98, which resulted in surface Mach numbers from approximately 3 to 7. Author

N64-25634 Southwest Research Inst., San Antonio, Tex.
AN EXPERIMENTAL INVESTIGATION OF FLUTTER OF A FULLY SUBMERGED SUBCAVITATING HYDROFOIL
H. Norman Abramson and Guido E. Ransleben, Jr. 15 Dec. 1963 31 p refs
(Contract Nonr-3335(00))
(TR-4; AD-430091)

This paper presents the results of an investigation of the flutter characteristics of a fully submerged subcavitating hydrofoil. The foil suffered a catastrophic flutter failure at a speed of approximately 48 knots. Comparisons are made with various prediction methods, with neither the two-dimensional nor the three-dimensional theoretical calculations yielding results of the correct order of magnitude. Calculations employing measured three-dimensional oscillatory coefficients give a highly conservative prediction for flutter speed. Author

N64-25717 Aeronautical Research Council (Gt. Brit.)
WIND-TUNNEL EXPERIMENTS ON A RECTANGULAR-WING JET-FLAP MODEL OF ASPECT-RATIO 6
A. J. Alexander and J. Williams London, Min. of Aviation, 1964 37 p refs
(ARC-REM-3329; Supersedes ARC-22947) HMSO: 15s

Balance measurements of lift, pitching moment, and thrust on an aspect-ratio 6 half-model wing and body in a 13- × 9-ft wind tunnel are discussed, and compared with theoretical estimates. The experimental investigation concentrated mainly on full-span flap deflections and blowing (with body cutout), first without a tail unit, and then with a tailplane of variable incidence and height added to derive the mean downwash angles at a conventional fore-and-aft location. The effects of slot blockage and of part-span flaps on lift and thrust were also examined briefly. Author

N64-25718 National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.
THE UNSTEADY MOTION OF SLENDER WINGS WITH LEADING-EDGE VORTICES
B. D. Dore 6 Jan. 1964 19 p refs
(NPL-AERO-1087; ARC-25489; FM-3400; O-1815; S&C-3763)

The unsteady motion of thin, slender wings with leading-edge vortices is considered. Incompressible flow and slender-wing theory are assumed throughout, and use is made of an analogy between the unsteady flow and related steady flows. The particular motions treated are a sudden plunging motion, or change of incidence, and entry into a gust. For the first case, the flow in any transverse plane moving with the wing reaches its steady state as soon as that plane has traveled past the initial position of the leading apex of the wing. An extension of the theory of Brown and Michael is given to determine the strength of the vortex and its path from the leading-edge to the steady-state position. Preliminary results obtained are compared with experimental data. For the second case, use of the analogy shows that quasi-steady theory holds. The flow in any transverse plane is instantaneously in the steady state corresponding to the effective incidence produced there by the gust. Author

N64-25790 Itek Corp., Palo Alto, Calif. Vidya Div.
THEORETICAL INVESTIGATION OF STATIC COEFFICIENTS, STABILITY DERIVATIVES, AND INTERFERENCE FOR DUCTED PROPELLERS
A. R. Kriebel 31 Mar. 1964 144 p refs
(Contract NOw-62-0129-c)
(VIDYA-112)

The force and moment coefficients at angle-of-attack and their dynamic pitching derivatives are predicted by potential flow analysis for an isolated ducted propeller. The analysis is based upon Fourier expansion of the vorticity distribution and makes use of the previous theoretical results for ring wings at angle-of-attack and ducted propellers in axial flow. The present results extend those derived in detail for a short thin cylinder surrounding a uniformly loaded actuator disk. Although the actuator disk assumption is retained, the effects of large duct chord-to-diameter ratio, and the effects of duct camber, taper, and thickness are shown on the duct coefficients and their pitching derivatives. The theoretical results are compared with data for an isolated ducted propeller. The duct forces and moments measured by Grunwald and Goodson at angles-of-attack ranging between 20° and 90° are predicted within +45% and −15% by the potential flow analysis. The duct thrust force measured during hovering and axial flight is predicted within a few percent. A first-order analysis is made of the interference between a pair of ducted actuator disks in a free stream at angle-of-attack. The analysis is applied to estimate the static stability and damping in pitch for a VTOL aircraft configuration with four tilting ducted propellers similar to the X-22A aircraft. The force and moment on a ducted propeller employed on a research torpedo configuration are estimated by the present theory, neglecting interference with the hull, and the estimated values are compared with existing data from a rotating-arm towing tank. Author

N64-25811* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THEORETICAL AERODYNAMIC CHARACTERISTICS OF SHARP AND CIRCULARLY BLUNT-WEDGE AIRFOILS
Joseph W. Cleary and John A. Axelson Washington, NASA, Jul. 1964 35 p refs
(NASA-TR-R-202) OTS: $1.00

The inviscid hypersonic aerodynamic characteristics of circularly blunt-wedge airfoils are derived from numerical solutions. Hypersonic wedge theory based on explicit oblique-shock equations is shown to provide rapid estimates of the pressures over both sharp and blunt airfoils. The effects of varying the airfoil wedge angle and bluntness and of varying the gas specific-heat ratio are evaluated. The hypersonic wedge theory provides an accurate prediction of the conditions at shock detachment for sharp airfoils for any value of gas specific-heat ratio. For the limiting case of infinite Mach number and a specific-heat ratio of unity, the theory is in agreement with Newtonian impact theory. The exact maximum lift–drag ratios and the lift coefficients at maximum lift–drag ratio for sharp airfoils at infinite Mach number are shown. Variation of gas specific-heat ratio has large effects on the aerodynamic characteristics of blunt and sharp airfoils at hypersonic Mach numbers. The lift curves are demonstrated to be highly nonlinear and to depart significantly from impact theory as the gas specific-heat ratio is increased. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-24824* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

GROUND MEASUREMENTS OF SONIC-BOOM PRESSURES FOR THE ALTITUDE RANGE OF 1,000 TO 75,000 FEET

Harvey H. Hubbard, Domenic J. Maglieri, Vera Huckel, and David A. Hilton Washington, NASA, Jul. 1964 45 p refs (NASA-TR-R-198) OTS: $1.25

Sonic-boom measurements are presented for flight tests of fighters and bombers in the altitude range from 10,000 to 75,000 ft and at Mach 1.1 to 2, for a variety of atmospheric wind and temperature gradients and for various flight paths and acceleration rates. Measurements of the pressure signatures at 17 locations both parallel and perpendicular to the airplane flight track were recorded simultaneously and were synchronized in time. The pressure signatures measured were similar to N-waves, but in all cases they differed in some detail. The shape of the pressure signature from a supersonic airplane is a function of atmospheric conditions, altitude, Mach number, flight path, configuration of the airplane, and relative position on the observer. As a result of airplane acceleration, more complex wave patterns and pressure magnifications are measured at some ground locations. The pressure magnification factors for a linear acceleration and a circular turn were noted to be approximately 2 and 4, respectively. The measured overpressures associated with very high altitude, steady-flight conditions of the bombers are greater than the predicted values. Author

N64-24966* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

FLIGHT EVALUATION OF THREE TECHNIQUES OF DEMONSTRATING THE MINIMUM FLYING SPEED OF A DELTA-WING AIRPLANE

Bruce G. Powers and Neil W. Matheny Washington, NASA, Jul. 1964 31 p refs
(NASA-TN-D-2337) OTS: $0.75

The Civil Air Regulations stall-speed demonstration currently used for civil transport aircraft was found to be inadequate for demonstrating the minimum speed of a delta-wing airplane, because this type of airplane does not have a well-defined stall point near the maximum lift coefficient. The 1 g minimum speed, which is based on maintaining a constant 1 g normal acceleration, was difficult to determine precisely, especially when buffeting was present. The constant-rate-of-climb minimum-speed maneuvers, which are based on the ability to maintain a constant rate of climb, were reasonably easy to perform and were unaffected by the aircraft buffet characteristics. The level-flight minimum speed obtained from the constant-rate-of-climb technique was found to be the most rational minimum speed for a delta-wing aircraft. The applicability of these techniques to other types of aircraft was shown in limited tests on a sweptwing airplane. Author

N64-25003* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INFLUENCE OF AIRPLANE CONFIGURATION ON SONIC-BOOM CHARACTERISTICS

Henry W. Carlson Repr. from J. of Aircraft, v. 1, no. 2, Mar.–Apr. 1964 p 82–86 refs Presented at the AIAA/ASD (AFSC) Vehicle Design and Propulsion Meeting, Dayton, Ohio, 4–6 Nov. 1963
(NASA-RP-208)

An outline of current sonic-boom estimation methods is presented along with illustrations of the correlation of this theory with experimental data. The dependence of overpressure on configuration variables is examined, and design considerations tending to minimize the problem are explored. Both wind-tunnel and flight tests demonstrated conclusively that both volume and lift effects contribute to bow-shock overpressures. Experiment has shown that existing theory provides reasonably accurate estimates of overpressure, both for cases of thickness alone and for a combination of thickness and lift. Additional developments of the theory have made possible the definition of a lower bound of sonic-boom overpressure, which depends only on airplane length, weight, base area, and flight conditions. A corollary of the lower-bound concept provides airplane design methods that theoretically allow lower-bound overpressure values to be achieved. However, compromises with other design considerations will prevent anything more than a limited approach to lower-bound overpressures. Author

N64-25031 Training Center for Experimental Aerodynamics, Rhode-Saint-Genese (Belgium)

POWERED LIFT MODEL TESTING FOR GROUND PROXIMITY EFFECTS

P. E. Colin Oct. 1963 32 p refs
(Contract DA-91-591-EUC-2771)
(TCEA-TN-14; AD-437657)

The effect of ground proximity on the performance of powered lift vehicles was investigated on simple models using two different testing methods. Single and double-jet models representing VTOL configurations and an air-cushion model with peripheral jet were tested both in the wind tunnel, where a stationary plate immersed in the flow was used to represent the ground, and on a special rig, which allowed the models to be moved over a fixed ground plate. The lift and center-of-pressure locations were determined with both techniques for various model heights above the ground plate over a range of momentum coefficients. The results obtained with both methods are compared. Author

N64-25073 Aeronautical Research Council (Gt. Brit.)

A THEORETICAL ANALYSIS OF THE STABILITY OF AN AEROPLANE ON NORTHERLY HEADINGS WHEN CONTROLLED BY AN AILERON-STEERING AUTOPILOT MONITORED FROM A GYRO-MAGNETIC COMPASS

H. R. Hopkin, M. R. Watts, and D. E. Fry London, HMSO, 1964 58 p refs
(ARC-REM-3356; Supersedes RAE-IAP-1467, ARC-23390)
HMSO: £1 2s 6d

Long-period lateral oscillations of an aeroplane under automatic control on northerly headings are shown to be due to high speed in a region of large magnetic-dip angle accompanied by strong monitoring of the gyromagnetic compass and autopilot. Aerodynamic characteristics are not important, and speed is the predominant aircraft parameter. An approximate analysis assuming that the motion consists of coordinated turns is found reliable for many purposes. The requirement

of weak monitoring for insuring stability conflicts with the need for strong monitoring to restrict datum errors caused by random precession torques on the azimuth gyro and by drifts in the autopilot. Modifications to the compass precession signal may stabilize the motion, but usually at the expense of a deterioration in datum errors, or with insufficient reduction in oscillation amplitude on account of thresholds of rate gyros. Of the five modifications studied, two seem marginally acceptable, but the best way to preventing northerly heading oscillations is to employ a good azimuth gyro so that a weak monitor is feasible or, alternatively, to monitor the gyro from a sensor that is little affected by aircraft banked turns. The latter requires very good stabilization of the sensor if it is a magnetic detector. Author

N64-25109 National Research Council of Canada, Ottawa Flight Research Section

A FLIGHT INVESTIGATION OF THE EFFECTS OF WEATHERCOCK STABILITY ON V/STOL AIRCRAFT DIRECTIONAL HANDLING QUALITIES Aeronautical Report

D. F. Daw, D. G. Gould, and D. M. Mc Gregor May 1964 61 p refs

(LR-400; NRC-8038)

An investigation into the effects of various levels of weathercock stability on directional handling quality boundaries, defined in terms of angular rate damping versus control sensitivity, was undertaken using a V/STOL airborne simulator. The visual flight task performed by the pilots included hovering turns in the presence of a simulated wind, and a complete circuit terminated by a steep angle, low-speed approach to landing. Synthetic turbulence disturbed the simulator to produce realistic flight conditions and was found to be extremely important for meaningful results. As the weathercock stability was raised, large increases in both damping, dictated mainly by the acceptable level of disturbance due to the turbulence, and control sensitivity were required by the pilots for both normal and emergency operations. Author

N64-25116 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux

CONTRIBUTION OF THE ONERA TO THE STUDY AND DEVELOPMENT OF THE COMMERCIAL PLANE "CARAVELLE" OF SUD-AVIATION [CONTRIBUTION DE L'O.N.E.R.A. AUX ETUDES ET A LA MISE AU POINT DE L'AVION DE TRANSPORT "CARAVELLE" DE SUD-AVIATION]

[1958] 12 p In FRENCH

The acoustical problems and the dynamic behavior and aerodynamic characteristics of the Caravelle are discussed. I.v.L.

N64-25130 National Research Council of Canada, Ottawa National Research Labs.

TURBINE DRIVES FOR VTOL TURBOFANS: PRELIMINARY RESULTS WITH AN EXPERIMENTAL TIP TURBINE DRIVE

G. G. Levy, E. P. Cockshutt, G. Faucher, and T. E. Guthrie Nov. 1963 58 p refs

(NRC-7761; LR-388; AD-437263)

A 36-in.-diameter tip turbine-driven VTOL fan incorporating a free-floating turbine blade carrier is described. The blade carrier remained eccentric over the speed range covered and limited the maximum rotational speed to 79% of that desired. Turbine and fan performances are presented, and the results of a comparison between the latter and a 12-in.-diameter model are discussed. Author

N64-25203 Aeronautical Research Council (Gt. Brit.)

CONTROL-SURFACE BUZZ

N. C. Lambourne London, HMSO, 1964 20 p refs

(ARC-R&M-3364; Supersedes NPL-AERO-1015; ARC-23786)

HMSO: 7s 6d

The term "buzz" as used here refers to a class of control-surface oscillations sometimes encountered during flight at transonic or low supersonic speeds. Essentially these are self-excited oscillations in a single degree of freedom—namely, rotation of the flap about its hinge. Buzz can be associated with several regimes of flow, and it is likely that the mechanism of excitation is different for each type. At least one form of instability can be related to negative aerodynamic damping predicted theoretically and does not depend on boundary-layer effects. Other forms of buzz depend on the occurrence of shock-induced separation ahead of the flap hinge, or on the presence of shock waves at the surface of the flap itself. The parameters that determine buzz characteristics are discussed, together with the available information relevant to the prevention of buzz in practice. Author

N64-25361* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NOISE AND SONIC BOOM CONSIDERATIONS IN THE OPERATION OF SUPERSONIC AIRCRAFT

Harvey H. Hubbard and Domenic J. Maglieri N.Y., AIAA [1964] 15 p refs Presented at the Intern. Council of Aeron. Sci., Paris, 24–28 Aug. 1964

(AIAA Paper-64-548) AIAA: 3 Fr.

The nature of the community noise problem is reviewed and is evaluated particularly for initial climbout, landing approach, and ground operations. Mention is also made of the noise-induced structural response problem during takeoff and cruise. Discussions are given of sonic-boom ground overpressure exposures for current supersonic flight operation and how these exposures are affected by the atmosphere and by aircraft maneuvers. Brief remarks are included about various operations for which some sonic boom community response information was obtained and for which building response is noted to be an important factor. Author

N64-25366 Radio Corp. of America, Camden, N.J. Communications Systems Div.

X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. FINAL DESIGN ANALYSIS REPORT

31 Mar. 1964 162 p

(Contract AF 33(657)-7134)

(CR-64-408-35-1; AD-437172)

The purpose of this report is to document a number of tasks that have significantly influenced the design of the communications and tracking subsystem, and that had not been completely described at the time the contract was canceled. These tasks are associated with the following areas: (1) trajectory analyses; (2) slant ranging accuracy; (3) link analyses; (4) X-20 surface site saturation; (5) superhigh frequency propagation; (6) the superhigh frequency communications site survey at Edwards AFB; (7) telemetry system analysis; (8) exerciser-simulator studies of the communications and tracking subsystem surface sites; and (9) the application of the X-20 superhigh frequency transmission equipment to other reentry vehicles. Included are examples of superhigh frequency attenuation caused by clouds and precipitation. I.v.L.

N64-25434 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE OPERATION OF AN AIR-INTAKE AND ITS CONTROL SYSTEM IN A PERTURBED ATMOSPHERE
V. I. Novikov *In its* Autom. Control of Aircraft Eng. 3 Dec. 1963 p 36–75 refs (See N64-25431 17-01)

This report considers the effect of the action of air gusts in a turbulent atmosphere on the surge reserve of the air intake and the selection of the optimum parameters for the automatic control system of an air intake so that this effect can be kept at a minimum. An equation of the dynamics of an air intake, having an excess-air cutoff control system and a system controlling the cone position, is derived. A surge-reserve equation is also derived, and the effect of the operating regime of an air intake and the parameters of a turbojet engine with afterburner on the surge are determined. I.v.L.

N64-25436 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RELIABILITY AND INCREASE IN THE WORKING LIFE OF THE CONTROL AND FUEL-SUPPLY EQUIPMENT OF GAS-TURBINE ENGINES
G. P. Anuchkin *In its* Autom. Control of Aircraft Eng. 3 Dec. 1963 p 85–96 (See N64-25431 17-01)

This survey of materials from foreign periodicals includes the following: (1) investigations, conducted by NASA, of the operational reliability of a turbojet engine and a study of the factors affecting the operational reliability and the actual working life of such an engine; (2) U.S.A. data concerning failures of main engine systems in commercial airlines from the beginning of the operation of the Boeing 707 with J-57 engines; (3) data concerning the reliability of the hydraulic pumps of the Lockheed Electra; (4) Dart engine failures; (5) measures taken by the Dowty firm to decrease the wear of abrasion components in fuel pumps; (6) measures taken by the Lucas firm to increase the reliability of a vibrating unit (fuel pump); (7) the development, by the Hamilton Standard Division of United Aircraft, Inc., of a hydromechanical rpm regulator for the General Electric T-58 for use in helicopters; and (8) Proteus-705 and CJ-805-3 engine operational data. I.v.L.

N64-25594 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
INVESTIGATION OF THE EFFECT OF LAPSE RATE ON BALLOON ASCENT RATE Final Report
Ralph D. Reynolds May 1964 15 p refs
(ERDA-140; AD-600433)

The relationship between temperature lapse rate and balloon ascent rate has been investigated for large (2,000-lb gross load) polyethylene "skyhook" balloons and the relatively small neoprene rawinsonde balloon. In general, the results indicate that the lapse rate is a minor factor in determining balloon ascent rate and should be considered only after other pertinent factors are better understood. Author

N64-25654 Weapons Research Establishment (Australia)
A PROGRAMME FOR PREDICTING THE IMPACT POINT OF A BALLISTIC ROCKET USING THE DIGITAL IMPACT COMPUTER (REVISED VERSION TO ALLOW FOR A SECOND SOURCE OF FPS16 RADAR DATA)
M. J. Allen Jan. 1964 128 p refs
(WRE-TN-TRD-12)

A program to predict the impact point of a ballistic rocket by using a digital impact computer is described in terms of the method of simulating the computer on an IBM-7090, requirements to be met by the program, calculations carried out, decision criteria, and ancillary programing. The validity of the simulation program was proven. G.D.B.

N64-25703 Hydronautics, Inc., Laurel, Md.
NON-STEADY HYDRODYNAMIC CHARACTERISTICS OF A SUPERCAVITATING HYDROFOIL UNDER A FREE SURFACE
C. C. Hsu Apr. 1964 51 p refs
(Contract NOBS-90224)
(TR-463-2; AD-601908)

The principal interest here is to clarify, both qualitatively and quantitatively, the influence of a free surface on the nonsteady two-dimensional hydrodynamic characteristics of supercavitating hydrofoils. Heaving, pitching, and flapping motions are considered. In general, the added mass forces and moments depend only slightly on the submergence depth–chord ratio of the hydrofoil. However, the other nonsteady forces and moments vary appreciably with the depth of submersion. At a depth–chord ratio of unity (typical value) the nonsteady characteristics are not well approximated by either the deeply submerged or surfaced hydrofoil results. The prediction of hydrofoil flutter or of transient foil or flap response will thus depend very much on the hydrofoil submergence. Author

N64-25807* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STALLING AND TUMBLING OF A RADIO-CONTROLLED PARAWING AIRPLANE MODEL
Charles E. Libbey and Joseph L. Johnson, Jr. Washington, NASA, Jul. 1964 15 p refs Film Supplement to This Report is Available on Loan from Langley Research Center
(NASA-TN-D-2291) OTS: $0.50

A free-flight investigation of a radio-controlled parawing model has been made to determine the dynamic stability and control characteristics over a large angle-of-attack range with emphasis on studies of post-stall dynamic behavior. The model consisted basically of a rectangular platform fuselage with a pylon structure, which supported the parawing overhead and was powered by a pusher propeller located at the rear of the platform. The results of the investigation showed that the model had dynamic longitudinal and lateral stability and was controllable in the normal operating range of angle-of-attack, although there was a decrease in lateral control effectiveness as the angle-of-attack was increased. In gentle stalls the model showed no tendency toward rolloff and no spinlike motion was encountered. Recoveries from such stalls could be effected readily by proper use of the pitch control. After whip stalls, however, the model could develop an extremely violent dynamic longitudinal instability in the form of a nose-down, end-over-end tumbling motion. At times tumbling could be avoided, and the model could be recovered from violent stalls by the use of corrective pitch control provided this control was applied soon enough and provided the pitching angular momentum was not allowed to become excessive. Author

N64-25808* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC BOOMS FROM AIRCRAFT IN MANEUVERS
Dominic J. Maglieri and Donald L. Lansing Washington, NASA, Jul. 1964 10 p refs
(NASA-TN-D-2370) OTS: $0.50

Superboom measurements and calculated pressure patterns have been made for fighter aircraft in level accelerated flight and in turn maneuvers. A summary of the main findings

of these superboom studies, qualitative comparisons with analysis, and a physical explanation of some of the observed phenomena are presented. From 2 to 6 booms were observed (compared with the normally observed 2 booms for steady flight), and pressure-buildup factors of from 2 to 4 were measured (depending on the type of maneuver and the location of the observer). The relative positions of the multiple shocks were predicted within 1,000 ft, and the location of the initial superboom impact was found to be predictable within about ±2 miles when the temperature profile and airplane position information were available. Author

N64-25810* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
YLR99-RM-1 ROCKET ENGINE OPERATING EXPERIENCE IN THE X-15 AIRCRAFT
James F. Maher, Jr., C. Wayne Ottinger, and Vincent N. Capasso, Jr. Washington, NASA, Jul. 1964 27 p refs
(NASA-TN-D-2391) OTS: $0.75

The YLR99 rocket engine has provided safe operation in the X-15 aircraft and has performed well in flight. Key factors that have made possible the excellent flight experience of the YLR99 engine are: (1) incorporation of basic design concepts of single-malfunction safety; (2) a rigidly imposed set of maintenance checkout requirements on the ground, including necessary ground firings in the aircraft; (3) prelaunch operations of most of the engine components; and (4) preoperation and postoperation engine inspections, coupled with checkout requirements. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-24489 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TO THE NEAR AND DISTANT UNIVERSE
16 Jul. 1963 450 p refs Transl. into ENGLISH of the Manuscript "Do Blizkeho i Vzdaleneho Vesmiru" Prague, Rozhlasova U., 1960 p 1–328
(FTD-TT-62-7/1+2+3+4; AD-413009)

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N64-24490 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE MOON—THE NEAREST BODY IN THE UNIVERSE
Josef Sadil *In its* To the Near and Distant Universe 16 Jul. 1963 p 2–21 (See N64-24489 17-05)

Brief discussions of the following are presented: (1) size and mass of the moon; (2) orbit of the moon around the earth; (3) phases of the moon; (4) earthshine; (5) lunar atmosphere; (6) temperature of the moon's surface; (7) composition of the moon's surface; (8) lunar mineralogy; (9) lunar radioactivity; (10) telescopic view of the moon's surface; (11) formation of lunar seas and craters; (12) life on the moon; (13) origin of the moon; and (14) astronomic observations on the moon. P.V.E.

N64-24491 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE PLANETS—SIBLINGS OF OUR EARTH
Joseph Sadil and Miroslav Plavec *In its* To the Near and Distant Universe 16 Jul. 1963 p 22–48 refs (See N64-24489 17-05)

The various properties of the planets making up the solar system are briefly discussed. Subjects included in the discussion are (1) distinguishing between a planet and a star; (2) properties of Mercury, Venus, Mars, Jupiter; (3) history of Jupiter's red spot and its properties; (4) storms on Jupiter; (5) Saturn's rings; (6) properties of Saturn, Uranus, Neptune, and Pluto; (7) the possibility of planets beyond Pluto; and (8) internal structure of planets. P.V.E.

N64-24492 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MORE DISTANT INHABITANTS OF OUR SOLAR SYSTEM
Vladimir Guth and Zoenek Ceplecha *In its* To The Near and Distant Universe 16 Jul. 1963 p 49–85 (See N64-24489 17-05)

Materials found in the space between the larger bodies of the solar system (planets, satellites, etc.) are discussed. Comets, asteroids, meteors, and meteorites are included in the discussion of interplanetary matter; also discussed is the very fine meteoric dust and the cloud it forms—zodiacal light. P.V.E.

N64-24493 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology DIV.
THE HISTORY OF THE SUN AND THE SOLAR SYSTEM
Kilosav Kopecky and Boris Valnicek *In its* To The Near and Distant Universe 16 Jul. 1963 p 86–113 (See N64-24489 17-05)

Early attempts to explain the origin of the solar system are discussed, along with more recent hypotheses. Also discussed are solar activity, differences between stars and planets, and planetary development. P.V.E.

N64-24494 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CELESTIAL MECHANICS
Vladimir Guth and Jaroslav Ruprecht *In its* To the Near and Distant Universe 16 Jul. 1963 p 114–143 (See N64-24489 17-05)

A discussion of problems involved in the launching of an earth satellite are discussed as follows: (1) the principle of inertia; (2) gravitational attraction; (3) parameters that determine a satellite orbit; (4) artificial planetoids; and (5) determining the shape of the earth. P.V.E.

N64-24497 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE WORLD OF THE STARS
Miroslavec Plavec and Zdenek Svestka *In its* To the Near and Distant Universe 16 Jul. 1963 p 220–286 (See N64-24489 17-05)

Questions that arise when the activities of the universe are considered are discussed as follows: (1) distance to the stars; (2) absolute stellar brightness; (3) white dwarfs; (4) changes in star brightnesses; (5) variable stars on the Hertzsprung–Russell diagram; and (6) the possibilities of the sun becoming a nova. P.V.E.

N64-24498 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERSTELLAR MATTER
Zdenek Svestka and Vladimir Vanysek *In its* To the Near and Distant Universe 16 Jul. 1963 p 287–312 (See N64-24489 17-05)

The following subjects are included in the discussion of interstellar matter: (1) the hypothesis of luminiferous ether; (2) distribution of interstellar dust in space; (3) diffuse and planetary nebulae; (4) differences between gaseous and dusty nebulae; (5) reason for radiation from the gas in a nebula; (6) formation of planetary nebulae; and (7) radio-astronomical research on interstellar hydrogen. P.V.E.

N64-24499 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STELLAR SYSTEMS
Lubos Perek and Jaroslav Ruprecht *In its* To the Near and Distant Universe 16 Jul. 1963 p 313–337 (See N64-24489 17-05)

Systems that are made up of individual stars (stellar systems) are discussed. The composition of double stars, star clusters, and galaxies are considered. P.V.E.

N64-24500 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
GALAXIES AND THE UNIVERSE
Vaclav Bumba and Lubos Perek *In its* To the Near and Distant Universe 16 Jul. 1963 p 338–364 (See N64-24489 17-05)

The following subjects are included in the discussion of galaxies and the universe: (1) different types of galaxies; (2) galactic clusters; (3) the local supergalaxy; (4) collisions between galaxies; (5) the red shift; (6) drifting apart of the universe; and (7) the role of the universal magnetic field. P.V.E.

N64-24501 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE ORIGINS OF THE ELEMENTS IN THE UNIVERSE
Josip Kleczek *In its* To the Near and Distant Universe 16 Jul. 1963 p 365–380 (See N64-24489 17-05)

The discussion on the origins of the elements in the universe includes the following subjects: (1) the chemical composition of the Milky Way; (2) the evolution of the elements—before the beginning of nuclear transmutations, initial nuclear reactions, conversion of hydrogen to helium, and the genesis of carbon and other elements; (3) the existence of elements heavier than hydrogen in the sun and in the earth; and (4) formation of elements in stellar atmospheres. P.V.E.

N64-24502 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A TRIP BEYOND THE SOLAR SYSTEM
Milan Blaha and Jan Bukovsky *In its* To the Near and Distant Universe 16 Jul. 1963 p 381–410 (See N64-24489 17-05)

Problems that will be encountered in attempting interstellar and intergalactic space flights are considered. In general, it is concluded that the basic problem in interstellar travel is how to obtain an adequate power source; most rocket systems proposed so far would not meet the extremely stringent requirements imposed by a trip to even the nearest star. P.V.E.

N64-24503 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
LIFE ON THE PLANETS OF OTHER SUNS
Josip Kleczek *In its* To the Near and Distant Universe 16 Jul. 1963 p 411–427 (See N64-24489 17-05)

The factors that determine where man can and cannot go in the universe are described. Included are examples of dangers that exist in interstellar travel. P.V.E.

N64-24556* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOLAR COLLECTOR DEVELOPMENT
Atwood R. Heath, Jr. and Preston T. Maxwell, (NASA. Washington) Repr. from Astronautics and Aerospace Eng., May 1963
(NASA-RP-223)

An attempt to assess the state-of-the-art of solar collectors (concentrators) is made. Presented are sketches of six different concepts of lightweight solar-energy collectors, not only those being considered but also those developed to a point where quantitative data on their capabilities exist. Examples of the six types, with some pertinent characteristics, are listed in an associated table. All are paraboloids, except the Fresnel. That is, essentially, a flat collector made up of annuli of paraboloids having a common focus. A description of each type, with some details of materials and methods of fabrication, is presented. N.E.A.

N64-24588* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE CAPABILITY OF A PROPORTIONAL-TYPE LATERAL CONTROL SYSTEM IN PROVIDING AERODYNAMIC HEADING-ANGLE TRAJECTORY CONTROL DURING REENTRY
Gene W. Sparrow Washington, NASA, Jul. 1964 38 p refs (NASA-TN-D-2343) OTS: $1.00

An analog investigation has been made to determine the capability of a proportional-type lateral control system of providing aerodynamic heading-angle control of a vehicle having a maximum lift-drag ratio of 2.0 during reentry into the earth's atmosphere. Heading-angle changes were accomplished by means of a heading-angle-command step input to control equations that caused the vehicle to assume a roll attitude. Both roll and Dutch roll damping were augmented. The investigation was conducted at altitudes of 100,000, 150,000, and 210,000 ft. Control-system gains were varied at each of these flight conditions in an effort to determine the

effects of these gains on the vehicle response. Results indicate that a sideslip-rate damper was superior to a yaw-rate damper in minimizing the magnitude of sideslip angle during roll. Author

N64-24646 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FORTY YEARS OF ASTRONOMY IN THE USSR, 1917–1957 (PART I)

A. A. Mikaylov, M. S. Zverev, P. G. Kulikovskiy, A. G. Masevich, Ye. R. Mustel' et al 20 Jan. 1964 602 p Transl. into ENGLISH of the Publ. "Astronomiya v SSSR za Sorok Let 1917–1957" Moscow, Fizmatgiz, 1960 p 1–402
(FTD-TT-63-1149/1+2+4; AD-429455)

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16. STRUCTURE AND EVOLUTION OF STARS A. B. SEVERNYY p 498–509 (See N64-24662 17-05)
17. GASEOUS NEBULAE AND THE VARIABLE STARS V. A. Vorontsov-Vel'yaminov p 510–551 (See N64-24663 17-05)
18. RADIO ASTRONOMY I. S. Shklovskiy p 552–562 (See N64-24664 17-05)
19. COSMOGONY V. A. Ambartsuyan p 563–593 (See N64-24665 17-05)
20. HISTORY OF ASTRONOMY P. G. Kulikovskiy p 594–601 (See N64-24666 17-05)

N64-24647 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FORTY YEARS OF SOVIET ASTRONOMY

A. A. Mikhaylov *In its* Forty Yr. of Astronomy in the USSR 1917–1957 (Pt. I) 20 Jan. 1964 p 1–15 (See N64-24646 17-05)

Soviet contribution to astronomy in the last 40 years is compared with that made under Tzarist rule. The astronomer's role in the growth of Soviet science is reviewed. J.R.C.

N64-24648 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

OBSERVATORIES AND INSTRUMENTS

O. A. Mel'nikov *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 16–72 (See N64-24646 17-05)

This is a history of the development of Russian observatories and their equipment from the time of Peter the Great to the contemporary Soviet scene. Much of this article is devoted to the important Pulkovo Observatory, as well as the Crimean Astrophysical Observatory and many other Soviet centers of astronomy. G.D.B.

N64-24649 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FUNDAMENTAL ASTROMETRY

M. S. Zverev *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 73–124 (See N64-24646 17-05)

Fundamental astrometry is astronomy without radio astronomy and astrophysics. This classical and therefore older discipline within astronomy has in the last decade been stimulated by modern computing techniques leading to important discoveries in ephemeridal astronomy, among others. This is a review of past and current Russian efforts in this area. G.D.B.

N64-24650 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PHOTOGRAPHIC ASTROMETRY

A. N. Deyts *In its* Forty Years of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 125–162 (See N64-24646 17-05)

A review is presented of work accomplished in photographic astronomy in the Soviet Union during the last 40 years. The determination of the motion of weak stars, the cataloging of weak stars, and the accuracy in weak star studies are discussed in terms of photographic astronomy. J.R.C.

N64-24651 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

LATITUDE SERVICE

Ye. P. Fedorov *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 163–180 (See N64-24646 17-05)

To solve the multitude of problems in astronomy, geodesy, and geophysics, it is necessary to have exhaustive data on the movement of the momentary axis of the earth's rotation. The International Latitude Service performs these tasks; its history and development is reviewed. G.D.B.

N64-24652 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THEORETICAL ASTRONOMY

M. F. Subbotin *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 181–214 (See N64-24646 17-05)

The accomplishments in the Soviet Union in theoretical astronomy during the last 40 years are reviewed. The role of new calculating techniques in the acceleration of theoretical astronomy, along with the value of astonomical year books, is discussed. J.R.C.

N64-24653 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PHYSICAL CONDITIONS ON THE MOON AND PLANETS
N. P. Barabashov *In its* Forty Years of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 215–262 (See N64-24646 17-05)

This is a review of Soviet studies of physical conditions on the moon and planets. Discussed are the methods of computation and observation; photometry, colorimetry, and polarimetry of the moon; radio emission and other problems in selenology; physical libration of the moon; observations of lunar eclipses; Venus; Mars; Jupiter; Saturn and its rings; and small planets. G.D.B.

N64-24654 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
COMETS
S. V. Orlov and S. M. Poloskov *In its* Forty Years of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 263–295 (See N64-24646 17-05)

A review of scientific knowledge of comets is presented, emphasizing Soviet developments in this field. Included in the discussion are the theory of comet nuclei, the mechanical theory of comet forms, the physics of comets, and their origin and evolution. G.D.B.

N64-24655 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
METEORITES
E. L. Krinov *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 296–328 (See N64-24646 17-05)

This is a general review of facts and history concerning meteorites, especially work done in the U.S.S.R. The vast expanse of Soviet territory has been host to large quantities of meteoric materials, a decided advantage in making the study of meteorites a Russian scientific specialty. G.D.B.

N64-24656 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE SUN
V. P. Vyazanitsyn *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 329–362 (See N64-24646 17-05)

This is a Soviet review of scientific knowledge, past and present, on the sun. Russian scientists, institutions, and theories dealing with solar problems are discussed. G.D.B.

N64-24657 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STELLAR ASTRONOMY
P. P. Parenago *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 363–421 (See N64-24646 17-05)

Soviet stellar astronomy is reviewed in terms of globular clusters, open stellar clusters, stellar associations, dark nebulae, general galactic absorption, determination of proper stellar motions and their explorations, practical dynamics of stellar systems, and galactic potential and galactic orbits of stars. G.D.B.

N64-24658 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
VARIABLE STARS
B. V. Kukarkin *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 422–445 (See N64-24646 17-05)

A general survey of variable stars is made, with special emphasis on the research and discoveries of Russian astronomers. G.D.B.

N64-24659 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ECLIPSING VARIABLE STARS
D. Ya. Martynov *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 446–466 (See N64-24646 17-05)

RU Monocerotis, AH Cephei, M Cephei, U Sagittae, and many other eclipsing variable stars have been observed and studied by Soviet scientists. This article reviews knowledge and history of this stellar group. G.D.B.

N64-24660 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PHYSICS OF STELLAR ATMOSPHERES (OBSERVATION PART)
B. A. Vorontsov-Vel'yaminov *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 467–481 (See N64-24646 17-05)

Observation techniques to enhance knowledge of the physics of stellar atmospheres by Soviet scientists are discussed. Advances in spectophotometry are described. G.D.B.

N64-24661 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PHYSICS OF STELLAR ATMOSPHERES (THEORETICAL PART)
V. V. Sobolev *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 482–497 (See N64-24646 17-05)

The physics of stellar atmospheres is discussed from a theoretical viewpoint, giving credit to Soviet theorists in this field. Variable stars and the sun are examined separately. G.D.B.

N64-24662 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STRUCTURE AND EVOLUTION OF STARS
A. B. Severnyy *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 498–509 (See N64-24646 17-05)

The problem of structure and evolution in stars is exceedingly complex, and therefore its solution is proceeding forward at a slow pace. Progress made in this area is summarized with mention of prominent researchers. G.D.B.

N64-24663 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
GASEOUS NEBULAE AND THE VARIABLE STARS
V. A. Vorontsov-Vel'yaminov *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 510–551 (See N64-24646 17-05)

In the past decade, great attention has been paid in the Soviet Union to the study of gaseous nebulae. Work done in this field and in the specialty of unstationary stars is discussed. G.D.B.

N64-24664 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADIO ASTRONOMY

I. S. Shklovskiy *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 552–562 (See N64-24646 17-05)

Radio astronomy is a very young science. Its beginning goes back to 1931, to the pioneering investigations by the American radio physicist Karl Jansky, the first to perceive and understand the phenomenon of cosmic radio emission. During World War II, the rapid development of radar technique gave great impetus to radio astronomy, and today Soviet scientists have taken great interest in this scientific specialty; their work is summarized. G.D.B.

N64-24665 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

COSMOGONY

V. A. Ambartsumyan *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 563–593 (See N64-24646 17-05)

Supertheoretical debates concerned with the origin of the universe from a physical point of view are mentioned. The conflicting theories of Soviet cosmogenists, among themselves and with westerners, are discussed. G.D.B.

N64-24666 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

HISTORY OF ASTRONOMY

P. G. Kulikovskiy *In its* Forty Yr. of Astronomy in the USSR, 1917–1957 (Pt. I) 20 Jan. 1964 p 394–601 (See N64-24646 17-05)

This is a history of Russian astronomy, beginning in the 18th Century and developing the thesis that the creation of the Soviet Government was the major factor in upgrading and expanding Russian astronomical efforts. G.D.B.

N64-24762 Joint Publications Research Service, Washington, D.C.

THE ORIGIN OF THE SOLAR NEBULA

F. Hoyle (Cambridge U., England) *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 14–55 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

The origin of the solar nebula is discussed in terms of the problem of angular momentum—general considerations regarding the angular momentum of stars, the transfer of angular momentum, transmission of torque by the magnetic field, magnitude of the torque, conductivity of a planetary gas, energy, massive stars with high surface temperature, condensation of planetary material close to the inner boundary of the disk, planets of the terrestrial group, the great planets, satellite systems of Jupiter and Saturn, and the accumulation of the terrestrial planets. G.D.B.

N64-24764 Joint Publications Research Service, Washington, D.C.

DISTANCES AND MASSES OF PLANETS

B. Yu. Levin *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 60–62 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

The relationship between distances and masses of neighboring planets is discussed. It is considered that Oort's cometary cloud was formed by the ejection of bodies perturbed by massive embryos of major planets. Author

N64-24765 Joint Publications Research Service, Washington, D.C.

ACCUMULATION OF PLANETS OF THE EARTH GROUP

V. S. Safronov *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 63–68 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

The accumulation process is calculated. The growth rate and the initial t^o of the earth are estimated. Some questions on gravitational instability in the dust component of the protoplanetary cloud, the disruption of colliding bodies, and the rotation of the planets are discussed. Author

N64-24767 Joint Publications Research Service, Washington, D.C.

THE ORIGIN OF METEORITES VIEWED IN CONNECTION WITH THE ORIGIN OF THE SOLAR SYSTEM

H. C. Urey (Calif. U.) *In its* Probl. of Cosmogony, Vol. VII 25 May 1954 p 71–73 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

The author discusses the properties of bodies formed in the protoplanetary cloud, and studies the process of the fractionation of the silicate and metallic phases in planets and meteorites. Author

N64-24832* National Aeronautics and Space Administration, Washington, D.C.

LUNAR RADIO EMISSION—THE PHYSICAL STATE AND NATURE OF THE MOON'S SURFACE [RADIOIZLUCHENIYE LUNY, FIZICHESKOYE SOSTOYANIYE I PRIRODA YEYE DOVERKHNOSTI]

V. S. Troitskiy Jul. 1964 32 p refs Transl into ENGLISH from Izv. Komis po Fiz. Planet, Akad. Nauk UKR. SSR, no. 3, 1961 p 16–30

(NASA-TT-F-172) OTS: $0.75

On the basis of investigations of lunar radio emission at wavelengths of 0.4 and 3.2 cm, radio data are not consistent with the widely accepted two-layer model of the lunar surface, which postulates the existence of a thin non-heat-conducting layer covering the dense lunar rock and transparent to radio waves; therefore, this model should be discarded. The nature of the dependence of the lunar radio emission on the wavelength unambiguously indicates that the properties of the outer layer are quasihomogeneous, at least to a depth of the order of 1 m. Author

N64-24870 National Academy of Sciences—National Research Council Washington, D.C.

UNITED STATES PROGRAM FOR THE INTERNATIONAL YEARS OF THE QUIET SUN 1964–65

M. A. Pomerantz May 1964 62 p

The American program for the International Quiet Sun Years 1964–1965 is outlined into specific categories of endeavor, namely meteorology, geomagnetism, aurora, airglow, ionospheric physics and radio astronomy, the sun and the interplanetary medium, cosmic rays and geomagnetically trapped radiation, aeronomy, world days, and world data centers. G.D.B.

N64-24902* Consultants and Designers, Inc., Arlington, Va.

COLLAPSE OF A STAR WITH ALLOWANCE FOR COUNTERPRESSURE [KOLLAPS ZVEZDY S UCHETOM PROTIVODAVLENIYA]

M. A. Podurets 29 Apr. 1964 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (USSR), v. 154, no. 2, Jan. 1964 p 300–301

(Contract NAS5-2078)

(NASA-TT-F-8689)

Currently all the data on nonstationary solutions of the general theory of relativity equations for spherically symmetric

stars are limited to dust data. For the real equation of the state of cold Fermi gas, the combination of statistical equations for spherical stars is well known. Presented in this report are the numerical integrations of Einstein equations for the case of a cold Fermi gas, when the mass of the star exceeds the value of M_{max}. G.D.B.

N64-24970* Consultants and Designers, Inc., Arlington, Va.
EXPRESSION IN SPHERICAL COORDINATES FOR THE POTENTIAL OF A MAGNETIC DIPOLE SITUATED AT ANY POINT IN SPACE AND HAVING A MAGNETIC MOMENT OF ANY DIRECTION
Yu. D. Kalinin Jan. 1964 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 3, no. 6, 1963 p 1089–1093
(Contract NAS5-2078)
(NASA-TT-F-8668; ST-GM-10107)

This paper brings forth the expression in spherical coordinates for the potential V of a magnetic dipole, situated at a point with spherical coordinates ρ, θ_0, λ_0, and having a magnetic moment M, forming the angle ψ with the surface of the sphere $\nu = \rho$ and an angle with the surface of a cone $\theta = \theta_0$. Author

N64-24978 Illinois U., Urbana
THE UNIVERSITY OF ILLINOIS RADIO TELESCOPE Progress Report 1 Jan.–31 Mar. 1964
G. C. Mc Vittie and G. W. Swenson, Jr. 8 Apr. 1964 8 p
(Contract Nonr 1834(22))
(PR-19; AD-436849)

Progress is reported in the primary mission of surveying the accessible sky. Minor additions were made to the instrumentation. Steel tie-rods and buck-frames, which were installed in the truss, arrested the progressive distortion of the truss, producing some correction. G.D.B.

N64-24989* Space Technology Labs., Redondo Beach, Calif. Physical Research Lab.
MICROMETEORITE IMPACT STUDIES Final Report
J. C. Slattery 30 Jun. 1964 37 p
(Contract NAS3-3569)
(NASA-CR-54057; STL-8447-6010-SU-000)
OTS: $3.60 ph

The burst of free charge produced by a hypervelocity particle impact was investigated. The hypervelocity particles were iron spheres with diameters ranging from 0.1μ to 1.0μ. The amount of charge produced per unit impacting particle mass was measured for several target materials at velocities from 3 km/sec to 25 km/sec. The effect was found to be independent of target temperature to 600° C, of electric field to 10^6 volts/meter, and of small amounts of cesium contamination. Self-sustaining electrical discharges have been initiated in simulated ion engines by hypervelocity particle impacts. Author

N64-24998* New Mexico State U., University Park Research Center
OBSERVATIONS OF THE RED SPOT ON JUPITER
Bradford A. Smith and Clyde W. Tombaugh Repr. from Publ. Astron. Soc. Pacific, v. 75, no. 446, Oct. 1963
(Grant NsG-142-61)

Photographic observations of the Red Spot on Jupiter were made on 33 dates between June 1962 and January 1963. The photographs, taken unfiltered on blue plates, were obtained with the center's 12-inch reflector using the 20-meter Cassegrain focus. Each plate contained 62 images taken at 30-second intervals, with the overall time interval centered on the estimated transit time of the center of the Red Spot across the central meridian of Jupiter. In addition, visual observations of transit times and of the general appearance of the planet were made. The 33 plates were examined for the general appearance of the planet in blue light, and estimates were made of the transit time of the center of the Red Spot across the central meridian. In addition, photometric measurements were made on selected plates of the brightness, in blue light, of the Red Spot and South Equatorial Belt Zone with respect to the Equatorial Zone. I.v.L.

N64-25056* National Aeronautics and Space Administration, Washington, D.C.
METEORITICS NO. 19
E. S. Burkser et al Jun. 1964 209 p refs Transl. into ENGLISH from Meteoritika (Moscow), 1960
(NASA-TT-F-100) OTS: $3.50

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N64-25057* National Aeronautics and Space Administration, Washington, D.C.
THE AGE OF METEORITES
E. S. Burkser *In its* Meteoritics No. 19 Jun. 1964 p 1–12 refs (See N64-25056 17-05) OTS: $3.50

The material in meteorites has not undergone such complex changes in composition and structure as have terrestrial rocks through the geological history of the earth. Therefore, the determination of the absolute age of meteorites is of great importance in solving the problem of the age of our planetary system. The presence of radioactive elements in stone and iron meteorites opens a path for establishing the absolute age of the material of which they are made. This paper discusses methods using this fact to determine the age of meteorites. G.D.B.

N64-25058* National Aeronautics and Space Administration, Washington, D.C.
SOME PROBLEMS OF THE CHEMISTRY OF METEORITES
A. A. Yavnel *In its* Meteoritics No. 19 Jun. 1964 p 13–31 refs (See N64-25056 17-05) OTS: $3.50

Chemical studies elucidating the formation and evolution of meteors in interplanetary space are presented in detail. Information from chemical studies related to movements of meteoric bodies in the atmosphere, to meteoric collisions with the earth's surface, and to changes in meteoritic material under terrestrial conditions is briefly discussed. D.E.W.

N64-25059* National Aeronautics and Space Administration, Washington, D.C.
THE PROBLEM OF TEKTITES AND SILICA-GLASSES
G. G. Vorob'yev *In its* Meteoritics No. 19 Jun. 1964 p 32–85 refs (See N64-25056 17-05) OTS: $3.50

Tektites and silica glasses are reviewed in terms of their local names and synonyms. The history of their discovery, and their nomenclature are discussed. The various tektites are examined individually; their chemical composition is given, and their shapes are illustrated. The geographical distribution, the scales of localization, and their geological sites are reported. G.D.B.

N64-25060* National Aeronautics and Space Administration, Washington, D.C.
AN X-RAY STUDY OF THE COMPOSITION OF CERTAIN METEORITES
N. N. Stulov *In its* Meteoritics No. 19 Jun. 1964 p 86–112 refs (See N64-25056 17-05) OTS: $3.50

The application of X-ray methods to the study of meteorites makes it possible to determine their composition more accurately and to establish patterns in the structure of meteoritic minerals in connection with their chemical composition. This makes it possible to interpret mineral associations in meteorites and in the earth's crust and to establish their crystallographic and mineralogical patterns. This article contains the results obtained from processing the X-ray diffraction patterns of a number of iron meteorites and some carbonaceous chondrites. G.D.B.

N64-25061* National Aeronautics and Space Administration, Washington, D.C.
AN X-RAY STUDY OF THE FUSED CRUST OF THE KUNASHAK STONE METEORITE
V. D. Kolomenskiy *In its* Meteoritics No. 19 Jun. 1964 p 113–129 refs (See N64-25056 17-05) OTS: $3.50

This is a continuation of a study of the Kunashak stony meteorite. Two samples of the meteorite were subjected to detailed X-ray study. All samples of the fused crust are powder of a dark gray color in which rare small grains of nickeliferous iron of a light gray were seen under a reading glass. The magnetic fraction consisting of nickeliferous iron, oxymagnetite, and josite was separated with a magnet. The magnetic fraction amounted to about 0.5% of the total quantity of powder. The nickeliferous iron was in the form of small, irregular, symmetrical grains of angular shape, measuring up to 0.1 mm. When the magnetic fraction was placed on a biscuit [porcelain block] and pulverized with another biscuit, an outline of black color characteristic of magnetite was obtained. G.D.B.

N64-25062* National Aeronautics and Space Administration, Washington, D.C.
DETERMINATION OF THE LEAD CONTENT IN IRON METEORITES
I. Ye. Starik, E. V. Sobotovich, and G. P. Lovtsyus *In its* Meteoritics No. 19 Jun. 1964 p 130–133 refs (See N64-25056 17-05) OTS: $3.50

The lead content in iron meteorites was determined by many investigators. The results obtained vary over very wide limits from $n \times 10^{-5}$ to $n \times 10^{-7}$ g/g, which can be explained by possible contamination by terrestrial lead and by the presence of irregular troilite inclusions in the metallic phase. The results obtained for some iron meteorites are presented in this article. A new method was applied for separating lead that will eliminate the shortcomings of the conventional chemical methods; it consists essentially of chemical decomposition of the sample with subsequent pyrochemical separation of the lead. G.D.B.

N64-25063* National Aeronautics and Space Administration, Washington, D.C.
PRELIMINARY RESULTS OF THE WORK OF THE TUNGUS METEORITE EXPEDITION OF 1958
K. P. Florenskiy, V. I. Vronskiy, Yu. M. Yemel'yanov, I. T. Zotkin and O. A. Kirova *In its* Meteoritics No. 19 Jun. 1964 p 134–175 refs (See N64-25056 17-05) OTS: $3.50

The absence of large destruction in the central part of the felled forest (the South Bog), the absence of visible craters from the explosion of the meteorite, the presence of a standing forest in the center of the catastrophe, the weak sheltering of trees from the action of the shock wave along the Churgima Creek—all these factors permit the assumption that the basic direction of the wave movement in this region was downward. G.D.B.

N64-25064* National Aeronautics and Space Administration, Washington, D.C.
ON THE DISCOVERY OF THE SUSUMAN IRON METEORITE
B. I. Vronskiy *In its* Meteoritics No. 19 Jun. 1964 p 176–186 refs (See N64-25056 17-05) OTS: $3.50

Background is given on the Susuman iron meteorite; its discovery, location, shape, weight, composition, age, and other pertinent data are discussed. The site of the meteorite is also described. G.D.B.

N64-25065* National Aeronautics and Space Administration, Washington, D.C.
THE LIFETIME OF COMETARY ICES IN THE FIELD OF PHOTON AND CORPUSCULAR RADIATION FROM THE SUN
V. I. Cherednichenko *In its* Meteoritics No. 19 Jun. 1964 p 187–205 refs (See N64-25056 17-05) OTS: $3.50

An attempt is made in this paper to calculate the lifetime of cometary nuclei consisting of pure ices, and to compare the results with those obtained from cometary statistics. The effectiveness of the assimilation process of the decay products OH and H in the original parent water molecules is examined. G.D.B.

N64-25123* Consultants and Designers, Inc., Arlington, Va.
FATE OF A STAR AND LIBERATION OF GRAVITATIONAL ENERGY AT ACCRETION [SUD'BA ZBEZDY I VYDELENIYE GRAVITATSIONNOY ENERGII PRI AKKRETSII]
Ya. B. Zel'dovich 29 Apr. 1964 7 p refs Transl. into ENGLISH from Dokl. AN SSSR, Astron. (Moscow), v. 155 no. 1, 1 Mar. 1964 p 67–69
(Contract NAS5-2078)
(NASA-TT-F-8688; ST-SA-10133)

The mechanism of energy liberation, which is linked with the fall of outer masses in the gravitational field of a contracting star is considered. The velocity of a free-falling particle tends to get nearer the speed of light as it approaches the gravitational radius. The collision of two particles, at a distance of the order of the gravitational radius, takes place with a relative velocity of the c order. Consequently, at collision, the radiation energy of the relativistic particles can be αmc^2; the energy, carried at infinity, is smaller. Due to the red shift and the geometric factor, part of the emission and of the mass

of particles falls on the star. The outward energy yield is equal to $\alpha\beta mc^2$, where m is the mass of the particles, $\alpha < 1$, $\beta < 1$. This product reaches a maximum of the order of 0.1 mc^2 at collision on $r = 1.5\ r_g$. It is essential that the colliding particles have a different vector of the rotation moment relative to the star. If collisions seldom take place, then for a given particle distribution by velocities at remote distances from the star, the energy liberation is proportional to the collision cross section. However, if it is assumed that the incident flow of the matter upon the star takes place at supersonic directed velocity, far from the star, a shock wave emerges from the star's side that is opposite to the direction of the origin of flow. Near the star the velocity variation in the wave front is of the order of c, and a noticeable fraction of mc^2 of matter, compressed by the wave, is emitted. I.v.L.

N64-25278* Consultants and Designers, Inc., Arlington, Va.
SHOCK WAVE RADIO EMISSION NEAR THE EARTH AND IN THE INTERPLANETARY GAS [RADIOZLUCHENIYE IZ UDARNYKH VOLN U ZEMLI I V MEZHPLANETNOM PROSTRANSTVE]
M. A. Gintsburg 15 May 1964 13 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 2, no. 1, 1964 p 65–70
(Contract NAS5-2078)
(NASA-TT-F-8699; ST-IS-PF-10141)

A new effect is considered here—the radio emission in the 10 to 30 kc/s frequency range, which must emerge from the leading shock wave near the Earth and planets. The intensity of such emission estimated in the paper allows the raising of the question of its experimental detection. Referred to are also other effects conditioned by the shock wave—particle acceleration by oblique solitary pulses (Fermi mechanism), trapping and acceleration by plasma waves. Author

N64-25282* National Aeronautics and Space Administration, Washington, D.C.
STELLAR EVOLUTION. I. A PROGRAM FOR THE SOLUTION OF THE TIME-DEPENDENT BASIC EQUATIONS [STERNENTWICKLUNG. I. EIN PROGRAM ZUR LOSUNG DER ZEITABHANGIGEN AUFBAUGLEICHUNGEN]
E. Hofmeister, R. Kippenhahn, and A. Weigert Jun. 1964 41 p refs Transl. into ENGLISH from the GERMAN
(NASA-TT-F-8740)

In this paper a program is described for stellar evolution computations, based on the Henyey method. The program shall be used for very different phases of stellar evolution. Therefore, the main program for the solution of the time dependent basic equations is kept as general as possible, while all assumptions about special physical conditions in the star occur only in subprograms. Hence the range of applicability of the program can easily be extended. The system of difference equations and details of the integration method used in the program are given. For a first test the program was applied to the post main sequence evolution of a star of 7 M. Some technical details of these calculations are given and discussed here. The program turned out to be applicable to calculations of the evolution near the main sequence, of phases of core contraction and of nuclear burning in shell sources. Author

N64-25540* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE PROBLEM OF ATMOSPHERIC OPTICS ABOARD ARTIFICIAL SATELLITES
F. Link 18 Jun. 1964 10 p refs
(Contract NAS-5-2078)
(NASA-TT-F-8912; ST-OA-10158)

The problem of atmospheric optics aboard artificial satellites is discussed in terms of the relation between the topocentric and geocentric directions, the luminous intensity of rays, the deformations of the sun, the eclipse of artificial satellites, the twilight fringe, reflection on sheets of water, and dioptric tables of the earth's atmosphere. G.D.B.

N64-25587 Land-Air, Inc., Holloman, N. Mex.
TELESCOPE TUBE EFFECTS ON OPTICAL TURBULENCE Final Report
P. F. Gott Jan. 1964 20 p refs
(Contract DA-29-040-AMC-6(R))
(LA-64-1; AD-435628)

Schlieren instrumentation has been utilized to study the optical effects of heat transfer between telescope tubes and the air within the tube. A method has been devised to reduce these effects. Metal tubes were set up in a schlieren system and heated by infrared lamps to simulate heating by sunlight under field conditions. The effect on seeing was studied as the tubes were heated by the infrared lamps and as other parameters were changed. Author

N64-25615* Consultants and Designers, Inc., Arlington, Va.
MAGNETIC FIELDS OF COLLAPSING MASSES AND THE NATURE OF SUPERNOVAE [O MAGNITNYKH POLYAKH KOLLAPSIRUYUSHCHIKH MASS I PRORODE SVERKHZVEZD]
V. L. Ginzburg 17 Jun. 1964 9 p refs Trans. into ENGLISH from Dokl. AN SSSR, Astron., v. 156, no. 1, 1 May 1964 p 43–46
(Contract NAS5-2078)
(NASA-TT-F-8910; ST-IGA-10156)

The discovery of supernovae and the attempts to fir[illegible]e mechanism of radiogalaxy formation draw attention to the problem of gravitational collapse of large gas masses. Attempts were made to analyze the various possibilities and astrophysical data, starting from the hypothesis of great mass collapse. This analysis was conducted in two directions—the first, based on passing the limits of existing physical representations and the second, based on the fact that a collapsing protostar has a gravitational field. G.D.B.

N64-25620* Consultants and Designers, Inc., Arlington, Va.
GRAVITATIONAL WAVES AND "SUPERSTARS" [GRAVITATSIONNYYE VOLNY I "SVERKHZVEZDY"]
I. S. Shklovskiy and N. S. Kardashev 19 Jun. 1964 6 p refs Transl. into ENGLISH from Dokl. AN SSSR, Astron., v. 155, no. 5, 1964 p 1039–1041
(Contract NAS5-2078)
(NASA-TT-F-8913; ST-IGA-10159)

This report examines some important effects of the general theory of relativity that have not been adequately applied to the problems of supernovae and gravitational collapse. The powerful emission of gravitational waves must play an essential part in the balance of energy and in the matter of a collapsing supermassive body. Two mechanisms of gravitational wave emission by a supermassive collapsing object are considered. G.D.B.

N64-25761 Naval Observatory, Washington, D.C. Nautical Almanac Office
ASTRONOMICAL PHENOMENA FOR THE YEAR 1966
Washington, GPO, 1962 12 p GPO: $0.25

Included in this survey of astronomical phenomena for 1966 are phases of the moon, morning and evening stars, eclipses, rising and setting phenomena of sun and moon, sunrise and twilight, sunset and twilight, moonrise, moonset, religious calendars, and civil calendars. G.D.B.

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-24280 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SYNTHESIS OF SYSTEMS TO ACCOMPLISH OPTIMUM FILTRATION
A. A. Gorskiy 16 Dec. 1963 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Tekhn. Kibernetika (Moscow), no. 1, 1963 p 42–50
(FTD-TT-63-1108/1+2+4; AD-428502)

Consideration is given to the question of determining the characteristics of a linear stationary system that is optimum with respect to random effects. A compensating loop in the system must satisfy the additional condition that the difference of the highest degrees of the numerator and denominator in its generalized transfer functions not exceed some reference number. Author

N64-24391 Harshaw Chemical Co., Cleveland, Ohio Crystal-Solid State Div.
RESEARCH ON PHOTOVOLTAIC CELLS Quarterly Progress Report, 1 Nov. 1963–31 Jan. 1964
Donald J. Harvey and Norman E. Heyerdahl Feb. 1964 15 p refs
(Contract AF 33(657)-7916)
(QPR-7; AD-439672)

Progress is reported on the CdTe thin-film solar cell. The high contact resistance observed between evaporated CdTe and molybdenum was circumvented by the inclusion of evaporated layers of Zn, Al, Ga, In, or In_2Te_3 between the CdTe and the molybdenum. A program was devised to examine the essential features of the chemistry of CdTe photovoltaic barrier formation in aqueous solution. Special apparatus was designed and constructed for this purpose. In addition, various GaAs evaporated films were annealed at temperatures up to 550° C to ascertain the effect of doping and annealing upon polycrystalline GaAs films. Author

N64-24711 Joint Publications Research Service, Washington, D.C.
MODELLING OF AUTOMATIC CONTROL SYSTEMS
Ye. M. Vavilov et al 16 Jun. 1964 68 p refs Transl. into ENGLISH from Avtomatyka (Kiev), v. 9, no. 2, 1964
(JPRS-25097; OTS-64-31490)

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4. INVARIANCE AND AUTONOMY IN AUTOMATIC SYSTEMS CONTAINING A "BLACK BOX" V. V. Pavlov p 47–52 refs
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N64-24845* Harshaw Chemical Co., Cleveland, Ohio Crystal-Solid State Research Lab.
RESEARCH AND DEVELOPMENT IN CdS PHOTOVOLTAIC FILM CELLS Final Report, 29 May 1962–10 Jun. 1964
T. A. Griffin, R. W. Olmsted, and J. C. Schaefer [1964] 56 p refs
(Contract NAS3-2493)
(NASA-CR-54108) OTS: $5.60 ph

This CdS thin-film solar-cell program has materially contributed toward an increase in the watts per pound, cell size, and an improved cell package. It has also produced an increase in the cell efficiency by means of an improved collector and has shown a method for possibly improving said collector by electrodeposition. A large number of various sized cells have also been delivered for a great variety of environmental tests. Cell cost reductions have been effected. Work has been accomplished on cell series resistance, crystallite size, and evaporant powders. Author

N64-24884 Michigan U., Ann Arbor Infrared Lab.
RESOLUTION CAPABILITIES OF OFF-AXIS DETECTOR ELEMENTS IN PARABOLOIDAL OPTICAL SYSTEMS
William L. Brown June 1964 44 p refs
(Contract DA-36-039-SC-78801; Proj. Michigan)
(Rept.-2900-475-T; AD-601888)

This report presents a new approach to the optical analysis of infrared detection systems, which avoids the ambiguous nature of spot diagrams. By analyzing an ideal paraboloidal optical system, a unique equation is derived that can be used to determine how much light, emitted from a point source and incident upon the collecting aperture, is actually focused upon a given detector. The alignment of a detector element both along the optical axis (focusing) and normal to the optical axis (centering) is shown to be critical. The IBM 704 digital computer was used to obtain numerical results showing that a maximum of 9 elements can be used with an f/1 system. Author

N64-24905* Electro-Optical Systems, Inc., Pasadena, Calif.
LARGE ALL-METAL SOLAR CONCENTRATORS FOR SPACE POWER SYSTEMS
D. H. Mc Clelland, L. M. Springer, and D. E. Stewart N.Y., AIAA [1964] 13 p refs Presented at the AIAA First Ann. Meeting and Tech. Display, Washington, 29 Jun.–2 Jul. 1964
(Contracts NAS3-2782; AF 33(616)-8402)

Large solar-dynamic electric power systems for space vehicles are being developed by the government. This paper discusses the design of lightweight, accurate, highly reflective solar concnetrators for these power systems. Folding petal mirrors up to 50-ft diameter and one-piece mirrors up to

30-ft diameter are considered. The various power conversion cycles are discussed. Required concentrator diameter is given as a function of system power level and power conversion efficiency. Design problems of large furlable and one-piece concentrators are discussed, including booster weight capability, allowable payload volume and envelope, accuracy and reflectance requirements, and reliability considerations. Design features of 20-ft and 30-ft one-piece mirrors and of a 45-ft furlable mirror are described, including performance, structural integrity, weight, packaging techniques, fabrication methods, and reliability. Author

N64-24941 Westinghouse Electric Corp., Pittsburgh, Pa.
CEROLYTE FUEL CELL First Quarterly Technical Progress Report
D. H. Archer et al [1964] 72 p refs
(Contract AF 33(615)-1425)
(AD-601817)

The development program for a 50-watt cerolyte hydrogen–oxygen fuel cell is progressing, with emphasis on electrode development and battery construction and testing. Testing of fused-platinum electrodes has shown that the following three factors must be carefully controlled during preparation: (1) the oxygen partial pressure around the sample at the time of fusion; (2) the maximum temperature reached in the process; and (3) the rate of cooling. The performance of some samples, prepared with an intermediate multicrystalline structure, indicates that low-polarization performance can be obtained that will support current densities of 600 milliamps/cm^2 or more. Batteries with fused fuel electrodes have demonstrated long life but have not demonstrated high output, whereas those with two conventional electrodes have demonstrated the ability to produce high output but have not yet been life-tested at high current densities. Since the life-limiting element of every battery tested has been the air (oxygen) electrode, the factors affecting the vaporization of platinum from the oxygen elextrode are evaluated. M.P.G.

N64-24964* National Aeronautics and Space Administration, Washington, D.C.
FUEL CELLS FOR AEROSPACE APPLICATION
George C. Szego and Ernst M. Cohn (Inst. for Defense Anal.) Repr. from Astronautics and Aerospace Eng., May 1963 p 107–111 refs
(NASA-RP-222)

The advantages of fuel cells for aerospace application and the problems encountered in their development are discussed. Systems for Gemini and Apollo will probably be the first functional fuel cells. NASA's diversified fuel-cell program is intended to serve the varied purposes and to fulfill the different requirements set by manned and unmanned space excursions, both brief and long. The various types of fuel cells being developed are described, and the progress to date is indicated. R.T.K.

N64-24985* American Cyanamid Co., Stamford, Conn. Stamford Research Labs.
RESEARCH AND DEVELOPMENT OF HIGH-PERFORMANCE LIGHT-WEIGHT FUEL CELL ELECTRODES Second Quarterly Report, 1 Feb.–30 Apr. 1964
R. G. Haldeman, W. A. Barber, and W. P. Colman 29 Jun. 1964 77 p refs
(Contract NAS3-2786)
(NASA-CR-54084) OTS: $7.60 ph

The overall object of this contract is the reduction of the weight-to-power ratio of the hydrogen–oxygen fuel cell. Work was done on the following: (1) materials studies including catalysts, supports, and matrices; (2) modification of thin platinum screen-type electrodes; (3) evaluation of cell operating variables; (4) life-testing of standard electrodes; and (5) engineering analysis of cell scale-up. Author

N64-25067* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
CORROSION PRODUCT SEPARATION IN A CROLOY 9M MERCURY LOOP Fourth Quarterly Report, 1 Feb.–30 Apr. 1964
D. B. Cooper and E. J. Vargo 11 May 1964 28 p
(Contract NAS3-2538)
(NASA-CR-54066; TM-3928) OTS: $2.60 ph

After 960 hours of operation, abrupt changes in flow occurred in the loop. Since no mercury was lost to the atmosphere with decreases in the condenser level, and since this level eventually became stable, it was proposed that some cavity in the system was filled with mercury. The explanation for this is that a crack developed in the inner shell of the liquid product separator, allowing the magnet cavity to fill with mercury. The boiler power was then increased, and the liquid level in the boiler was decreased to provide vapor of higher quality at the inlet of the vapor trap. These changes resulted in drying the vapor in the vapor trap. Following these changes, the loop operated without incident for an additional 762 hours until a total of 1,772 hours of operation had been accumulated. At this time, the heater on the superheater outlet failed. The loop was shut down, and the heater was replaced. The loop was restarted, and operation has continued without incident. A total of 2,765 hours has been accumulated. I.v.L.

N64-25085 Union Carbide Corp., Parma, Ohio Parma Research Center
THIN FUEL CELL ELECTRODES Second Quarterly Report, 1 Sep.–1 Dec. 1963
K. V. Kordesch [1963] 45 p
(Contract DA-36-039-AMC-02314(E))
(Rept.-2; AD-430802)

Manufacturing procedures of one type of thin electrode have been refined to a point at which output, operational life, and reproducibility were sufficiently high to warrant a more accurate determination of performance characteristics. Effect of gas composition changes, temperature increase, and variation of caustic concentration were determined, in turn leading to a better understanding of the composite mechanism of gas electrode operation. The collection of data on material properties has been continued with more work devoted to carbon powders. Three different metal backings have already been found suitable for thin electrodes. Author

N64-25209 Naval Ordnance Lab., White Oak, Md.
ELECTROMECHANICAL ENERGY CONVERSION BY MEANS OF VARIATION OF RELUCTANCE
Albert Preisman and Roland W. Schlie 25 Oct. 1962 13 p refs
(NOLTR-63-233; AD-427025)

An analysis is made of the conversion of mechanical energy, required to partition an iron-core magnetic circuit, into electrical energy in a secondary-coil circuit. Two cores having primary and secondary coils are employed. With the primary energized, the cores are assumed to be separated at a constant velocity, thereby increasing the magnetic reluctance as a function of time. The voltage and current induced in the secondary coil are calculated as well as the corresponding energy developed, for two different laws of variation of reluctance with distance. In one case the reluctance is assumed to vary linearly with distance, and in the second case it is assumed to vary as the square root of the distance. The latter

case simulates more nearly the effect of fringing of the magnetic flux. An analysis is then made of the optimum number of secondary turns required for a given winding volume for maximum power output in a secondary load resistance. Formulas are also developed for the voltage induced as a function of time and for the total energy output. Finally, experimental tests were made which, while crude, tend essentially to substantiate the formulas as well as to point to new test setups that will be more accurate. Author

N64-25211 General Electric Co., Auburn, N.Y. Rectifier Components Dept.
RESEARCH ON THIN FILM POLYCRYSTALLINE SOLAR CELLS Quarterly Technical Progress Report, 1 Jan.–31 Mar. 1964
R. W. Aldrich et al Wright-Patterson AFB, Ohio, Aero Propulsion Lab. [1964] 43 p refs
(Contract AF 33(657)-10601)
(Rept.-6; AD-438526)

This report discusses the research on thin film CdTe solar cells. Changes in the design of the vapor reaction apparatus are described and evaluated. The effects of changes in the growth conditions are described. Film adherence was found to improve greatly with the use of molybdenum substrates. Studies of the evaporated electrodes were continued, and some work was done on plated and silk-screened electrodes. Both soldered and epoxy-bonded connections to the evaporated grid were examined, with the latter believed to be the superior technique. Studies of the effects of crystal orientation on cell characteristics are reported. An improved CdSe cell is described, and further work on an n-on-p cell is reported. Author

N64-25294 Little (Arthur D.) Inc., Cambridge, Mass.
LOW TEMPERATURE OPERATION OF BATTERIES Quarterly Progress Report, 15 Dec. 1963–14 Mar. 1964
R. A. Horne and D. L. Richardson Ft. Monmouth, N.J., Army Electr. Labs. [1964] 27 p
(Contract DA-36-039-SC-90706)
(QR-6; AD-601599)

For short missions (less than 2 hours), the performance of insulated but unheated battery systems can be improved by using mercury or alkaline zinc cells rather than Leclanche cells. For longer missions, insulated systems with either combustion or electrical resistance heaters are capable of realizing capacities in excess of 10 w-hr/lb. Further improvement should be possible by improved insulation—still restricted to inexpensive insulating materials. Reduction of the airgap between battery and insulation does not drastically alter cool-down rates, but enables a more accurate prediction of system cool-down to be made. Author

N64-25316 General Instrument Corp., Newark, N.J. Thermoelectric Div.
WICK BURNER FOR THERMIONIC GENERATORS Report No. 1, May 1, 1963–Jan. 31, 1964
C. Teleki [1964] 24 p
(Contract DA-36-039-AMC-02236(E))
(Rept.-1, AD-600314)

A basic burner model with a simulated flat diode of 2.86 cm^2 area was designed, fabricated, and tested. The design incorporates a nonpressurized, wick-type gasoline vaporization system, and a heat exchanger for preheating the secondary combustion air by means of the hot exhaust gases. A number of different combustion chamber designs were tested to determine the optimum configuration. Difficulties encountered in measuring the diode heat flux led to the design and construction of an improved simulated flat diode. Tests performed on the improved burner model indicated a simulated emitter surface temperature of 1,415° C at a heat flux of 51 w/cm^2. Author

N64-25332 Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
OPTIMAL CONTROL OF LONG RUNNING STOCHASTIC SYSTEMS
Eleanor Kushel Baum (Ph.D. Thesis) Jun. 1964 56 p refs
(Grant DA-ARO(D)-31-124-G144)
(PIBMRI-1220-64; AROD-1538-28; AD-441554)

This dissertation deals with the optimal control of plants in which some uncertainty (due to noise or environmental disturbances) exists and whose time of operation is so long that it may be considered to be infinite. It is assumed that the uncertainties may be treated in a probabilistic manner and that the underlying probability distributions are known. The state space is taken to be continuous. The mean loss rate is chosen as the criterion of system performance, and the optimal controller must minimize this. An iterative procedure that leads to this optimal controller is derived for both the discrete time and the continuous time cases. Several illustrative examples of the use of this procedure are given. Author

N64-25373 Radio Corp. of America, Lancaster, Pa.
THE DEVELOPMENT OF A LOW-TEMPERATURE CYLINDRICAL THERMIONIC GENERATOR
W. B. Hall Jun. 1964 39 p
(Contract AF 33(615)-1547)
(QTR-1; AD-601906)

The specific objectives of the program include evaluation of existing samples, design and evaluation of improved modules, investigation of low-work-function collectors, investigation of high-temperature collector operation, and investigation of the effects of inert gas injection. The first three months of work on the subject contract covers the analysis of prior failures, a continuation of life testing to more than 4,300 hrs, and the initial design for an improved module. A control standard converter was fabricated for the investigation of low-work-function collectors. One sample collector material was evaluated. A convert design, A-1195, was modified for high-temperature operation, and one converter employing a molybdenum emitter and molybdenum collector was fabricated. Author

N64-25378 General American Transportation Corp., Niles, Ill. MRD Div.
DESIGN OF AN INTERNAL ENVIRONMENTAL SIMULATOR. INTERNAL ENVIRONMENTAL SIMULATOR FOR A MAN-MACHINE SYSTEM Final Engineering Report
R. A. Landes, R. B. Neveril, and C. M. Tomsic Oct. 1963 129 p refs
(Contract N61339-1097)
(NAVTRADEVCEN-1097-1; AD-442643)

The detail design was completed for fabricating a horizontally oriented ground trainer equipped to train operating personnel in the use of closed-system environmental devices at varying ambient pressures. It consists of two operating pressure chambers connected by a pressure-tight entrance lock, all capable of resisting 15 psi, internally or externally applied, and equipped with two separate external instruction stations and a block of support equipment. The command module of 300 ft^3 volume will fit inside the Device 9A12 Altitude Chamber and contains a ventilation, pressure control, oxygen supply, and suit pressure system to sustain three men for 48 hours. The environmental system operates off nonregenerable stored gases and is controlled by the crew. An external

instructor's station provides a TV screen, duplicate instruments, and problem-producing override controls. The mission module, of 890 ft^3 volume, contains a regenerable environmental system to provide ventilation, pressure control, oxygen supply, waste storage, water recovery, food storage, food preparation, and crew rest facilities. Automatic operation of this equipment is monitored and controlled by the three-man crew for a simulated 2-week mission, while an external instructor's station provides a TV screen, duplicate instruments, and problem-producing override controls. Author

N64-25439 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
REPORTS OF THE ACADEMY OF SCIENCES USSR (Selected Articles)
20 Jan. 1964 14 p refs Transl. into ENGLISH of 2 Articles from Dokl. Akad. Nauk SSSR (Moscow), v. 150, no. 1, May 1963 p 21–22, 48–51
(FTD-TT-63-1075/1; AD-433074)

CONTENTS:

1. ON THE EXISTENCE OF AN ABSOLUTE MINIMUM IN A PROBLEM OF THE THEORY OF OPTIMUM PROCESSES V. N. Kalinin p 1–4 refs (See N64-25440 17-06)

2. ABOUT LINEAR ELLIPTICAL SYSTEMS OF FIRST MAGNITUDE M. Z. Solomyak p 5–10 refs (See N64-25441 17-06)

N64-25440 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE EXISTENCE OF AN ABSOLUTE MINIMUM IN A PROBLEM OF THE THEORY OF OPTIMUM PROCESSES
V. N. Kalinin *In its* Rept. of the Acad. of Sci. USSR 20 Jan. 1964 p 1–4 refs (See N64-25439 17-06)

An effort was made to establish direct methods applicable to one problem of the optimum control theory. A theorem is given that adheres to the known Tonelli results in the classical variational calculation and establishes the existence of an absolute minimum in the formulated problem and minimizing sequence, converging toward the element and realizing the absolute minimum. G.D.B.

N64-25441 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT LINEAR ELLIPTICAL SYSTEMS OF FIRST MAGNITUDE
M. Z. Solomyak *In its* Rept. of the Acad. of Sci. USSR 20 Jan. 1964 p 5–10 refs (See N64-25439 17-06)

This paper explains the structure of elliptical systems of first magnitude with real coefficients in K-dimensional Euclidean space R_k. Also discussed is a system of simple structure in R_4. This system does not have even one integrodifferential boundary problem in any of the limited zones. G.D.B.

N64-25524 General Motors Corp., Indianapolis, Ind. Allison Div.
ENERGY DEPOT ELECTROLYSIS SYSTEMS STUDY Final Report
C. W. Schade, R. A. Foust, Jr., B. N. Thomson, M. J. Malik, W. L. Carr et al 1 Jun. 1964 219 p refs
(Contract AT(30-1)-3101)
(EDR-3714, Vol. 1)

The conceptual design of an efficient, lightweight, rugged, and compact mobile electrolysis unit for the production of hydrogen from water was evolved. The conceptual chemical plant will produce 7.15 T/day of anhydrous ammonia with a power source of 3000-kw supplied at 4160 v, 3-phase, and 60 cps. The chemical plant is composed of three transportable skids, each weighing 30,000 lb or less. Catalytic electrodes were developed that are highly efficient in terms of power required to dissociate water into hydrogen and oxygen. Both acid and base systems were investigated. Detailed studies were made of power conditioning equipment, liquid gas separators, and overall system optimization. Engineering drawings of a conceptual electrolysis unit and detail drawings of a prototype electrolysis module were a part of this study. Experiments to determine the effect of impurities from corrosion products or impure feed water are reported. Author

N64-25576 Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.
DESIGN OF CAPILLARY TYPE HYDROGEN-OXYGEN FUEL CELL Final Technical Report, 15 May 1962–31 Mar. 1964
N. P. Bannerton and R. H. Hum May 1964 172 p
(Contract AF 33(657)-8970)
(APL-TDR-64-54; AD-600658)

This report describes the development of the orbital package, component selection and integration into the system, and final qualification testing of the orbital fuel cell package. The program on the orbital package began with laboratory models that allowed preliminary investigation and evaluation of ideas leading toward package assembly and system operation. A temperature control system for the orbital package was developed, which, depending on shroud temperature variations, provided evaporative cooling or automatic switching of the fuel cell load and 28-v heaters. Environmental qualification tests including shock, vibration, acceleration, and a 100-hr thermal vacuum test were conducted successfully on the final package configuration. The orbital fuel cell package was also tested under short periods of weightlessness on a KC-135 jet aircraft. This testing did not have any noticeable effect on the performance of the fuel cell package. As a result of laboratory experimentation and subsequent environmental qualification testing of the orbital fuel cell package, information acquired during the program was used to formulate a composite conceptual design of a fuel cell system for a space vehicle electrical energy source. Author

N64-25593 California U., Los Angeles
ON PERFORMANCE LOSSES IN SOME ADAPTIVE CONTROL SYSTEMS, 1
Masanao Aoki Aug. 1963 27 p refs
(Contract Nonr-233(52))
(Rept.-63-23; AD-421575)

Loss of performance and percentage loss of performance are defined and approximately calculated in terms of moments of the distributions in order to determine an optimal estimate of the scalar quantity. It was noted that for certain system parameter combinations, the initial estimate is valid for all control periods, but for certain other parameter combinations, the estimate should be changed with time even though no additional information on the unknown parameter is gathered. Numerical procedures are given for the determination of optimal estimates of parameters. I.v.L.

N64-25762 Air Force Systems Command, Wright-Patterson AFB, Ohio Aero Propulsion Lab.
ELECTROCHEMICAL DEVICE FOR OXYGEN REMOVAL Bimonthly Status Letter No. 4, 1 Jan.–29 Feb. 1964
J. Mc Kee 16 Mar. 1964 8 p
(Contract AF 33(615)-1039)
(UNC-MTL-3722)

The first thoria–yttria cell tested in sodium cracked at 140 hr. Its current efficiency and current density were low, but it apparently did remove some oxygen from sodium. The second such test encountered rising cell resistance, a new development. The rise is tentatively ascribed to depletion of oxygen from a stagnant sodium layer around the cell. Electrolysis of a zirconia–calcia cell in sodium was interrupted by overheating of the O-ring seal. A revised seal, using forced air cooling, eliminated this problem. A zirconia–yttria cell electrolyzed in oxygen showed encouragingly high conductivity and current efficiency at 1,000° F. It also showed current efficiency increasing with current density up to a maximum before decreasing. This unexpected behavior has not been explained. Electrolysis of zirconia–calcia plates in oxygen indicated that this material will not be as useful as zirconia–yttria at temperatures below 1,400° F. Author

N64-25769* Marquardt Corp., Van Nuys, Calif.
BIOCHEMICAL FUEL CELLS Fourth Quarterly Report, 1 Feb.–30 Apr. 1964
George E. Ellis and Edward E. Sweeny [1964] 35 p ref
(Contract NASw-654)
(NASA-CR-56231; QR-25136; Rept.-4)

Investigations were conducted in pretreating human waste by adding selected microorganisms to sterilized (autoclaved) human wastes. The microorganisms selected were *Escherichia coli* and *Clostridium sporogenes*. These organisms were not as effective as indigenous microorganisms in producing electrical power. The effect of bubbling the fuel-anolyte with inert gas was also evaluated, and it was found to be effective in increasing the anodic open-circuit current density. Platinized platinum alloy screen (90% Pt–10% Rh) was found to be essentially as effective as platinized platinum foil for these reactions. The first experiment was conducted in which human waste is being degraded by electrochemical energy. Results have shown that the cathode (nonbiological) reaction is rate determining. Polarographic studies of relatively pure components of human waste are being initiated. Electrical power output from feces (in deionized water) was found to be negligible. Literature surveys are being continued in appropriate areas. Author

N64-25782 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
A REFERENCE SYSTEM FOR THE EVALUATION AND CALIBRATION OF MICRO-DISPLACEMENT READOUT SYSTEMS AT TEMPERATURES TO 500 C
J. C. Spanner, B. B. Brenden, and W. L. Nicholson Jan. 1964 26 p refs
(Contract AT(45-1)-1350)
(HW-80271)

A reference system for the evaluation and calibration of micordisplacement readout systems is described. The basic reference system consists of several pieces of precision readout and positioning equipment, a high-temperature test chamber, and a specially designed linkage system. The case temperature of the transducer under calibration is maintained constant to within ±0.5° C for temperatures to 500° C. A quartz and Invar Linkage system provides a minimum expansion method of coupling linear motion, through a heat shield, from the readout equipment to a transducer located in the test chamber. The reference system is periodically calibrated in the plant metrology laboratory, and a basic reference system precision of ±0.3% or better for operational ranges from 0.004 to 0.500 in. has been established. Author

N64-25785 Michigan U., Ann Arbor Navigation and Control Systems Lab.
STABILITY AND PERFORMANCE ANALYSIS OF A CERTAIN CLASS OF NONLINEAR TIME-VARYING FEEDBACK CONTROL SYSTEMS
A. Y. Bilal and Louis F. Kazda Jun. 1964 32 p refs
(Contract DA-36-039-SC-78801)
(Rept.-2900-348-R)

The partitioning technique and the state variable approach were applied to analyze and to study the behavior of a control system whose dynamic performance can in general be described by a nonlinear differential equation containing some linear terms, some nonlinear ones, and a forcing function. By placing suitable restrictions on the system equation, the state variables, which represent the state of the system, belong to an L_2 space. Under the assumed restrictions, the admissible system satisfied the definition of asymptotic stability in the sense of Lyapunov. By using two different definitions of the norm, the system trajectory was analyzed. During the interval of operation considered, expressions for the required norms were obtained inside of which all possible states of the system remain. Author

N64-25802* IIT Research Inst., Chicago, Ill.
SPACE BATTERY HAND BOOK
Howard T. Francis 15 Apr. 1963 90 p refs
(Contract NASw-401)
(NASA-CR-56514) OTS: $8.10

This handbook is written to aid the designer of a battery space-power system in his choice of batteries, charging methods, and a myriad of circuit components. It describes three sealed secondary battery systems (nickel–cadmium, and silver–zinc)—their basic electrochemistry, their characteristics with regard to charging and discharging rates, their behavior on overcharge, their energy storage capability, their life expectancy, and their reliability. Also, a mechanism of information exchange is discussed, whereby current test data can be rapidly shared among space contractors. I.v.L.

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-24266 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CORROSION OBSERVER
25 Feb. 1964 60 p Transl. into ENGLISH from Korrozios Figyelo (Hungary), v. 3, no. 4–5, 1963 p 65–100
(FTD-TT-63-1069/1+2; AD-435504)

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2. CORROSION PROTECTION AND RESEARCH IN THE CHEMICAL INDUSTRY ACID-RESISTANT METALS AND ALLOYS E. Szucs p 3–6 (See N64-24268 17-07)

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5. THE USES OF RUBBER AS PROTECTION AGAINST HYDROCHLORIC ACID K. Valkony p 18–23 (See N64-24271 17-07)

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10. NONMETALLIC STRUCTURAL MATERIALS IN THE PROTECTION AGAINST CORROSION BY HYDROCHLORIC ACID M. Batori p 33–39 (See N64-24276 17-19)

11. DATA CONCERNING RESISTANCE TO HYDROCHLORIC ACID IN THE LATEST SCIENTIFIC LITERATURE I. Bozso p 39–49 (See N64-24277 17-07)

12. RESEARCH REPORTER: THE TREATMENT OF THERMAL WATERS WITH SOLID INHIBITORS T. Peterfi p 50–52 (See N64-24278 17-07)

13. FORUM: CAN STEEL RUST IN REINFORCED CONCRETE? I. Szilagyi p 52–57 (See N64-24279 17-18)

N64-24267 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

IMPORTANCE OF CORROSION BY HYDROCHLORIC ACID IN THE HEAVY CHEMICAL INDUSTRY

Lajos Csurgai *In its* Corrosion Observer 25 Feb. 1964 p 1–2 (See N64-24266 17-07)

The uses and industrial production methods of hydrochloric acid are listed. Corrosive properties of dry and wet hydrogen chloride gas are briefly discussed, and materials for handling and storage apparatus are mentioned. Graphite impregnated with phenol and furan resins as well as polyvinyl chloride is suggested as being especially suited for handling, storing, and transporting the acid either as a gas or in solution. D.E.W.

N64-24268 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CORROSION PROTECTION AND RESEARCH IN THE CHEMICAL INDUSTRY ACID-RESISTANT METALS AND ALLOYS

Endre Szucs *In its* Corrosion Observer 25 Feb. 1964 p 3–6 (See N64-24266 17-07)

A number of alloys are listed and discussed in terms of availability in Hungary, of cost, and of corrosion resistance to salt or hydrochloric acid solutions of various concentrations and at different temperatures. D.E.W.

N64-24269 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PLASTICS RESISTANT TO HYDROCHLORIC ACID

Bela Kiss *In its* Corrosion Observer 25 Feb. 1964 p 6–9 (See N64-24266 17-07)

Hard polyvinyl chloride (PVC) is discussed as a piping material for transporting hydrochloric acid. Impact, thermal expansion, and high operating temperatures are mentioned as the most common sources of trouble in such piping systems. However, hard polyethylene seems to excell both hard PVC and soft polyethylene on the combined basis of cost, flexibility, impact resistance, available lengths, and strength. Polypropylene is rejected because of lower corrosion resistance and excessive brittleness at temperatures below 0° C. Lifetimes of various piping materials are discussed; these materials include plastic-lined steel tubes. D.E.W.

N64-24270 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DATA FOR THE DESIGN AND INSTALLATION OF HARD PVC PIPING

Istvan Daboczy *In its* Corrosion Observer 25 Feb. 1964 p 9–18 (See N64-24266 17-07)

Data are given in tabular and graphic form, and specifications for thermal expansion-compensating loops and joints in polyvinyl chloride (PVC) tubes and pipes are given in diagrams and in text. D.E.W.

N64-24271 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE USES OF RUBBER AS PROTECTION AGAINST HYDROCHLORIC ACID

Karoly Valkony *In its* Corrosion Observer 25 Feb. 1964 p 18–23 (See N64-24266 17-07)

Rubber linings and coatings of metal structures to protect against acid corrosion are discussed, and hard rubber, neoprene, and natural soft rubber are differentiated in weight, volume, and tensile strength responses to hydrochloric acid. Practical uses for each coating are listed. D.E.W.

N64-24275 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

REDUCING HYDROCHLORIC ACID CORROSION WITH INHIBITORS

Sandor P. Nagy *In its* Corrosion Observer 25 Feb. 1964 p 30–33 (See N64-24266 17-07)

The mechanism and advantages of inhibition are discussed. General inhibitors for acids include sulfur- and nitrogen-containing organic compounds. Effective inhibitors for hydrochloric acid in contact with iron, aluminum, and brass are listed. Some additives act selectively. All inhibitor concentrations at which maximum effect is found are very low. Synergetic effects are sometimes found. Inhibited hydrochloric acid, widely available in the U.S.S.R., is used only for cleaning of boilers and related equipment in Hungary, even though it can be used for many other purposes. D.E.W.

N64-24277 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DATA CONCERNING RESISTANCE TO HYDROCHLORIC ACID IN THE LATEST SCIENTIFIC LITERATURE. A SURVEY

Istvan Bozso *In its* Corrosion Observer 25 Feb. 1964 p 39–49 (See N64-24266 17-07)

Graphic and tabular information is presented on materials resistant to attack by hydrochloric acid.

The mechanism of a solution of iron in hydrochloric acid is described in a theoretical article. Two reactions are hypothesized, and pertinent data are collected. The effect of a fresh iron surface on the reaction rate is discussed, and it is concluded that the surface quality and the oxide-layer condition are determining factors. D.E.W.

N64-24278 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RESEARCH REPORTER: THE TREATMENT OF THERMAL WATERS WITH SOLID INHIBITORS
Tibor Peterfi *In its* Corrosion Observer 25 Feb. 1964 p 50–52 (See N64-24266 17-07)

The elimination of corrosion and scale formation was attempted in a piping system for thermal waters. Oxygen removal from the water was judged impracticable because of the cost, and inadvisable because of the probable subsequent rise in anaerobic bacteria content. Solid inhibitors were prepared by high-temperature fusion from a silicate and a phosphate, and variables such as grain size, layer thickness, water temperature, and water flow rate were investigated. The best combination of conditions produced an effective protection of 73%. D.E.W.

N64-24345 Naval Research Lab., Washington, D.C. Chemistry Div.
SURFACE POTENTIALS AND INDUCED POLARIZATION IN NONPOLAR LIQUIDS ADSORBED ON METALS
K. W. Bewig and W. A. Zisman 19 Jun. 1964 15 p refs (NRL-6068; AD-601528) OTS: $0.50

The contact potential difference between a metal and a suitably coated metal serving as a reference electrode can be used in clean air as a sensitive and reliable tool for studying adsorbed monomolecular films of polar compounds. The change (ΔV) in the contact potential difference resulting from the adsorption on a metal of a film is reported for each of the following pure, nonpolar liquid compounds: hexane, octane, decane, dodecane, tetradecane, hexadecane, cyclohexane, dicyclohexyl, benzene, toluene, xylene, and carbon tetrachloride. Clean polished surfaces of Pt, Au, Ag, Cu, Ni, W, Cr, Sn, and Cd were the adsorbing metals. Contact angles of water, glycerol, methylene iodide, and hexadecane on the same adsorbed films supplied information about their nature, packing, and orientation. Evaporation of the liquid always leaves on the metal an adsorbed monolayer oriented so that the maximum number of atoms contact the surface. When excess liquid is wiped off the metal by rubbing with clean filter papers, a monomolecular adsorbed film remains whose properties are identical with those obtained by evaporation. The electrostatic image field of the adsorbed molecule is not sufficient to cause the observed values of ΔV, and the parameters involved include the lattice spacing and atomic volume of the metal. Values of ΔV obtained were reproducible and characteristic for each compound and metal. Theoretical calculations of ΔV in terms of the molecular polarization induced in the adsorbed liquid molecules by the electrostatic field just outside of the surface of the metal agreed in order of magnitude with experimental data. As theory predicted, ΔV for any compound increased linearly with the electrostatic field intensity in the vicinity of the adsorbed molecules or the total energy necessary to extract a conduction electron from the metal. Author

N64-24450 Illinois U., Urbana
NUCLEAR MAGNETIC RESONANCE
H. S. Gutowsky 19 Mar. 1964 40 p refs Submitted for Publication
(Contract Nonr 1834(13))
(TR-70; AD-436099)

Analytical applications of nuclear magnetic resonance (NMR) include the following: (1) high-resolution NMR for chemical shifts and spin-spin coupling in liquids and gases; (2) broad-line NMR in solids for dipole-dipole interactions; and (3) radiofrequency pulse experiments for nuclear relaxation times. A particular NMR application, namely, the study of fast chemical-exchange processes, and the possibilities of radiofrequency pulse methods in such experiments are discussed in detail. D.S.G.

N64-24504 Battelle Memorial Inst., Columbus, Ohio
DEVELOPMENT OF ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF MINUTE QUANTITIES OF SELECTED ELEMENTS IN BERYLLIUM
W. M. Henry 24 Apr. 1964 8 p
(Contract NOw-64-0081-C)
(IR-1; AD-439727)

Investigations were made to determine the components of the residual gases in the source section of the vacuum spark mass spectrograph, while at rest and during spark ionization. Studies were made of the effects on the analysis of introducing traces of gases into the sample chamber. Other sources of atmospheric-component contamination were investigated to determine their effects on the analysis for gas contents. Author

N64-24566 Joint Publications Research Service, Washington, D.C.
PREPARATION OF PHOSPHORS BASED ON $CaSO_4$
A. R. Krasnaya, L. S. Revzin, V. Ya. Yaskolko *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 11–19 refs (See N64-24564 17-23) OTS: $1.50

Aspects of the technology of preparing phosphors based on $CaSO_4$ are investigated. Phosphors based on $CaSO_4$ with the activators Bi, Ni, Zn, Pb, Cd, Ag, Tl, Co, Mg, Hg, Sr, Sm, Sb, together with the phosphor of $CaSO_4$-Mn were prepared by the mixing and coprecipitation methods. The characteristics of preparing each phosphor are discussed. N.E.A.

N64-24618 Lockheed Missiles and Space Co., Palo Alto, Calif.
METHODS OF DETECTION AND QUANTIFICATION
M. Honma and R. W. Rinehart *In its* A Symp. on Toxicity in the Closed Ecol. System [1963] p 155–169 refs (See N64-24606 17-16)

This paper describes general analytical chemical principles and techniques applicable to the evaluation of toxicity in closed ecological systems. Emphasis is placed on the application of new chemical or physical principles to analytical needs, the prediction of future analytical possibilities, and the need for more work to assess the toxic potentials of system components. Three main topics are considered: methods of analysis, analytical chemical techniques for assessing potential sources of toxicity, and the effect of space conditions on the choice of analytical techniques. Author

N64-24834* National Aeronautics and Space Administration, Washington, D.C.
THE INFRARED ABSORPTION SPECTRUM OF WATER IN ITS LIQUID STATE [INFRAKRASNYY SPEKTR POGLOSHCHENIYA ZHIDKOY VODY]
K. Ya. Kondrat'yev et al Jul. 1964 29 p refs Transl. into ENGLISH from Probl. Fiz. Atmosfery, Sb. 2, Izd. Leningrad. Univ., 1963 p 87–112
(NASA-TT-F-211) OTS: $0.75

Measurements are presented with a view to defining the liquid water absorption factors within a wide spectral range. The optical densities were measured with two infrared spectrophotometers and prisms made of glass, lithium fluoride, rock

salt, and potassium bromide. Some of the shortcomings of the method are pointed out. Author

N64-24849 National Cash Register Co., Dayton, Ohio Capsular Research and Product Development Dept.
A STUDY OF THE ENCAPSULATION OF HIGH ENERGY SUBSTANCES Final Report, 1 Apr. 1959–31 Dec. 1963
Constantine C. Petropoulos Apr. 1964 65 p refs
(Contract Nonr-2848(00))
(AD-601772)

Research in the following areas is summarized: (1) film permeability studies; (2) the compatibility of various polymers with hydrazine; (3) the preparation of polyamides and two-stage polymers; and (4) encapsulation studies. Also discussed are polymer studies and further encapsulation studies. Polymer studies include the synthesis of prepolymers based on glycidyl methacrylate, 2-vinyloxyethyl methacrylate, 2-hydroxyethyl methacrylate, and on methallyl methacrylate, and the interfacial polycondensation of bisphenol A with a 1:1 mixture of terephthaloyl chloride and fumaroyl chloride. The encapsulation studies include the use of the cationic polymerization product of glycidyl methacrylate, the use of the vinyl homopolymer of glycidyl methacrylate, and amine encapsulation by interfacial polymerization. I.v.L.

N64-24916 Texaco Experiment Inc., Richmond, Va.
INVESTIGATION OF THE DISSOCIATION CHEMISTRY OF $-NF_2$ COMPOUNDS
U. V. Henderson, Jr., P. L. Goodfriend, H. A. Rhodes, and H. P. Woods 1 Aug. 1963 10 p refs
(Contract Nonr-1883(00))
(EXP-223; TM-1443; AD-418278)

A spectroscopic study of the NF_2 2,600 A absorption was made. This absorption is due to a progression yielding a value of 380 cm^{-1} for the ν_2 bending frequency of the upper state. The absorption is assigned as a $^2A_1 \leftarrow {}^2B_1$ transition. Flash photolysis experiments were made on N_2F_4. The flash heating effect previously found was the only kinetic feature observed. A search was made for the NF radical without success. Adiabatic compression experiments were made using mixtures containing N_2F_4 or NF_3 in helium with 1% argon at calculated temperatures between 800° K and 1,200° K. The results using N_2F_4 are ambiguous, and those using NF_3 are anomalous. Methods for overcoming these difficulties are considered. Author

N64-24938 Smith Coll., Northampton, Mass.
HEATS OF MIXING OF KCL-KBr SOLID SOLUTIONS
George S. Durham 1 Jun. 1964 6p
(Contract DA-19-020-5053; Grant DA-ARO(D)-31-124-G5)
(AROD-2477-1; AD-441350)

The presently accepted values of heats of mixing of KCl-KBr solid solutions are too high, due to strains and inhomogeneities in the samples used. In this investigation it was proposed to treat KCl-KBr solid solutions with pressures of the order of 10,000 atm in order to remove strains before making precise calorimetric determinations of their heats of mixing. A new differential calorimeter was designed, with a hoped-for accuracy of ±0.5% (±1 calorie out of 200 cal/mole heat of mixing). Four recent calibration runs have given the heat of solution of KCl (obtained differentially under conditions similar to projected heat-of-mixing measurements) with a precision of ±0.2% and agreement with the NBS value within 0.4%. Author

N64-24952 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
AMINO NITROGEN-15 TRACER STUDIES OF THE NITROLYSIS OF HEXAMETHYLENETETRAMINE
Thomas C. Castorina and Joseph R. Autera May 1964 49 p refs
(PA-TR-3116; AD-601786)

The path of amino nitrogens in the nitrolysis of hexamethylenetetramine (hexamine) to a mixture of the homologous cyclic methylenenitramines, 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane (HMX) and 1,3,5-trinitro-1,3,5-triazacyclohexane (RDX), was traced using nitrogen-15. The equilibration of hexamine and ammonium nitrate amino nitrogens in the formation of the stable intermediate, 1,5-dinitroendomethylene-1,3,5,7-tetraazacyclooctane (DPT), during the first stage of nitrolysis is attributed to exchange. Only the trimethylene-substituted and not the dimethylene-nitro-substituted amino nitrogens in DPT undergo interchange with the ammonium ion. DPT does not cleave selectively in the formation of HMX and RDX during the second state of nitrolysis. In the absence of paraformaldehyde $[(CH_2O)_x]$, HMX and RDX are derived essentially from hexamine nitrogens with only a small fraction of approximately 5% of RDX derived from ammonium nitrate. Author

N64-25002 Tufts U., Medford, Mass.
EFFECT OF THE INTERNAL FIELD ON VIBRATIONAL BAND SHAPES AND INTENSITIES IN LIQUIDS Dept. of Chemistry Contribution No. 293
Karl H. Illinger 15 Jan. 1964 20 p refs
(Contract Nonr-494(19))
(AD-431713)

An analysis is given of the effect of the frequency dependence of the internal field upon band shapes and intensities in infrared and Raman spectra of liquids. Band shape in the Raman case is independent of the form of an isotropic interral field, and therefore is a reflection of molecular interaction alone, whereas both effects are operative in generating infrared band shapes. Numerical calculations of infrared band shapes in liquids are presented for the Lorentz and Buckingham internal field functions. Author

N64-25086 Southwest Research Inst., San Antonio, Tex.
A STUDY OF RAPID SOLIDIFICATION OF HYDROCARBON FUELS Progress Report, Jan. 1–Feb. 1, 1964
E. C. Martin 14 Feb. 1964 10 p
(Contract DA-44-177-TC-819 (T))
(AD-439722)

New diisocyanates and amines were synthesized and evaluated. Polyureas as gelling agents are discussed. G.D.B.

N64-25087 University of Southern Calif., Los Angeles
KINETIC EQUATIONS OF THE BOGOLYOUBOV THEORY OF CLASSICAL GASES AS DERIVED FROM THE MARKOVIAN VERSION OF THE PRIGOGINE THEORY
J. Stecki and H. S. Taylor [1964] 31 p refs
(Contract Nonr-228(23))
(AD-429541)

The Bogolyubov theory of irreversible processes in classical gases in the λ-version and for homogeneous systems is discussed and evaluated within the framework of the Prigogine theory. It is proved that it leads exactly to the Markovian equation for the velocity distribution, and that it is equivalent to an asymptotic evaluation of ρ'' without introducing the instantaneous collision approximation. The conjecture of ρ' being neglected is confirmed. Author

N64-25112 Boston U., Mass.
SYNTHESIS OF SELECTED ETHERS, PHENOLS AND RELATED COMPOUNDS HAVING NITROGEN-CONTAINING GROUPS Final Report, Oct. 1, 1961–Mar. 31, 1964

Philip Mason, Raymond G. Mc Innis, Harry L. Hennessy, Pierre D. Lord, and John E. Eaton [1964] 53 p refs
(Contract DA-18-108-CML-6678)
(AD-439242)

This report is presented in three parts. Part one presents a continuation of work done on a series of compounds, which can be described as α-3-nitrophenoxy-ω-(3-nitro-5-dimethylcarbamyloxyphenoxy)-alkanes and α-(3-nitrophenoxy)-ω-(3-nitro-5-hydroxyphenoxy)-alkanes. Part two contains the methods used for the preparation of the various intermediates to be used in the synthesis of 1,3-bis(5-dimethylcarbamyloxy-3-pyridoxy)-propane and 1-(3-pyridoxy)-3-(5-dimethylcarbamyloxy-3-pyridoxy)-propane. Part three contains methods of preparing various aliphatic compounds containing two tertiary amine groups and two alcohol groups, or groups that could be converted to alcohols. N.E.A.

N64-25183 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
FLAME INHIBITION RESEARCH Quarterly Progress Report, 1 Aug.–31 Oct. 1963 (Yearly Summary, 1 Nov. 1962–31 Oct. 1963)
R. M. Fristrom, W. G. Berl, W. E. Wilson, J. T. O'Donovan, and S. Favin Nov. 1963 63 p refs
(SR 6-3; AD-439644; ERDL-21-61)

The current program status is as follows: (1) Rate profiles have been obtained for a lean methane–oxygen flame inhibited by HBr. (2) Hydrogen atom and hydroxyl radical composition profiles have been derived for both HBr and the CH_3Br inhibited flames, using known elementary rate expressions and the observed rates and compositions. (3) Rate profiles obtained are discussed in terms of kinetics and elementary reactions. (4) Preliminary kinetic constants are given for the reactions $HBr + OH \rightarrow H_2O + Br$ and $CH_3Br + OH \rightarrow CH_2Br + H_2O$. (5) A new electronic chassis has been ordered for the mass spectrometer, and the vacuum system is being cleaned and reconditioned. I.v.L.

N64-25220 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE BAND SPECTRUM AND DISSOCIATION ENERGY OF ClF
Heinz Schmitz and Hans Schumacher 15 May 1964 7 p Transl. into ENGLISH from Z. Naturforsc. (Tubingen), v. 2a, 1947 p 359–362
(RSIC-183; AD-602060)

The dissociation energy of the ground state D_0 gaseous ClF was determined. Depending upon whether a decomposition in normal Cl and excited F(excitation energy 1.1 kcal) or a decomposition in normal F and excited Cl (excitation energy 2.5 kcal) is assumed, the dissociation energy of the ground state D_0'' was (a) 59.8, (b) 60.4, (c) 60.7, and (a) 58.4, (b) 59.0, and (c) 59.3 kcal, respectively. Accordingly, the dissociation energy of ClF in the case of decomposition into excited F and normal Cl is 60.3 ±0.5 kcal, and in the case of the decomposition into excited Cl and normal F, 58.9 ±0.5 kcal. The edge of the first unsharp band lies at 21.257 cm^{-1} ~ 60.8 dcal. Photographs of the continuous absorption spectrum of ClF, which were evaluated only qualitatively, exhibited a pronounced absorption maximum at 2,750 A. If the band analysis presented is assumed to be correct, then it is possible to calculate, from D_{ClF} in combination with the heat effect of ClF formation, the dissociation energy of $F(D_{F_2})$. Depending on whether a value of 60.3 kcal or 58.9 kcal is used for D_{ClF}, the value of D_{F_2} obtained is 33.4 kcal and 30.6 kcal, respectively, a value that is only approximately one-half of that hitherto assumed to be correct. I.v.L.

N64-25401 Pennsylvania State U., University Park Whitmore Lab.
PARAMAGNETIC RESONANCE OF TRIPLET CYANOMETHYLENE Interim Technical Report
R. A. Bernheim, R. J. Kempf, P. W. Humer, and P. S. Skell 11 Jun. 1964 6 p refs
(Grant DA-ARO(D)-31-124-G211)
(AROD-3192-3; AD-442236)

Reported is the observation of the paramagnetic resonance of cyanomethylene, H-C-C≡N, in its triplet ground state. In this molecule, both triplet electrons are equally delocalized over the same parts of the molecule, and the zero field splitting might be expected to approach that of methylene itself. Any differences between this value and the methylene value arise from the additional nuclear charge due to the presence of the nitrogen atom. Cyanomethylene behaves as a triplet species in its chemical reactions. G.D.B.

N64-25492* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
REACTION OF O (^1D) WITH CO
O. F. Raper and W. B. De More Repr. from J. Chem. Phys., v. 40, no. 4, 15 Feb. 1964 p 1053–1057
(Contract NAS7-100)
(NASA-CR-56460; JPL-TR-32-571)

The photolysis of O_3 in liquid CO at 77° K has been studied with 2,537 A radiation. Carbon dioxide is formed with a quantum yield of 0.07 and in a 1:1 ratio with O_3 disappearance. The CO_2 quantum yield is reduced by addition of N_2, O_2, or Ar, but is increased by lowering the temperature of the solution. Formation of CO_2 is attributed to the reaction

$$O(^1D)+CO(+M)\rightarrow CO_2(+M),$$

and the low quantum yield is believed to be caused by the reaction

$$O(^1D)+CO+M\rightarrow CO+O(^3P)+M,$$

which leads to O_3 reformation. The reaction of $O(^1D)$ with CO is an example of an association process in which the excited association complex may undergo unimolecular decomposition to products of lower electronic energy in the course of stepwise vibrational deactivation. Formation of the association product is of higher order than one with respect to M, the actual order depending on the number of vibrational states in which unimolecular dissociation competes with collisional deactivation. Author

N64-25541 Regis Chemical Co., Chicago, Ill.
THE SYNTHESIS OF NON-COMMERCIALLY AVAILABLE ORGANIC COMPOUNDS Annual Technical Report, 1 Sep. 1962–31 Jan. 1964
Charles A. Feit, Eugene R. Carr, and Richard W. Shubart 25 Feb. 1964 74 p refs
(Contract DA 18-108-CML-6625)
(AD-439402)

The project was concerned with synthesizing organic chemicals not available commercially. The majority of the compounds are bridged bicyclic aminoketones. Most final products or their derivatives were submitted to microanalysis. An effort was made to identify all compounds as fully as possible through infrared spectroscopy and refractive index measurements, and to ascertain the degree of purity through thin-layer chromatography; these data are included. G.D.B.

N64-25557 Argentina Comision Nacional de Energia Atomica, Buenos Aires
OBTAINING PLUTONIUM TRACERS IN A CYCLOTRON [OBTENCION EN SINCROCICLOTRON DE TRAZADORES DE PLUTONIO]
M. B. Crespi, G. A. Dupetit, and R. T. Bonard 1963 11 p refs *Its* Informe no. 86 IN SPANISH

The optimum conditions were established for obtaining plutonium tracer from natural uranium in a cyclotron. The yield is maximum at 24.5 Mev, and the amount obtained with targets of 27 mg/cm^2 is enough for tracer uses. Since the plutonium obtained is mainly Pu^{236}, with a half-life of 2.7 years, its use in chemical studies increases the detection sensitivity of the element and diminishes the hazard associated with its handling. Author

N64-25559 Argentina Comision Nacional de Energia Atomica, Buenos Aires
OBTAINMENT AND ESTABLISHMENT OF 32-p LABELLED SODIUM PYROPHOSPHATE [OBTENCION Y ESTABILIDAD DE PIROFOSFATO DE SODIO (32p)]
Renato Radicella, Alcides F. Rega, and Ricardo A. Caro 1963 9 p refs *Its* Informe no. 103 IN SPANISH

The ^{32}P-labeled sodium pyrophosphate, with a radiochemical purity greater than 97%, is prepared by ignition between 500° and 550° C of 15 μM labeled disodium orthophosphate (20 mCi/mM) for 5 hours. The radiochemical purity of pyrophosfate (^{32}P) decreased when amounts of labeled orthophosphate smaller than 15 μM were utilized. Dry samples (40 mCi/mM) and aqueous pyrophosphate solutions (2.5μM/m1) at pH 8.5 and 10.0 are stable at least for 31 days, at room temperature. In acid media, pyrophosphate is decomposed to orthophosphate with 40 days and 108 days halflife at pH 1.0 and pH 6.0, respectively. Author

N64-25578 Texaco Experiment Inc., Richmond, Va.
INVESTIGATION OF THE DISSOCIATION CHEMISTRY OF $-NF_2$ COMPOUNDS Quarterly Summary Report, Feb.–Apr. 1964
U. V. Henderson, P. L. Goodfriend, and H. P. Woods 4 May 1964 6p refs
(Contract Nonr-1883(00))
(TM-1531; EXP 223; AD-439527)

Work has continued in the search for the electronic spectrum of the NF radical in the following areas: (1) a search of the vacuum ultraviolet for absorption bands of NF produced by flash photolysis of NF_2; and (2) a search for emission bands of NF produced by a fast discharge from a capacitor and by pulsed electrodeless radiofrequency discharges. Work in the first area is not yet finished. In the second area, experiments have not shown any sign of an emission spectrum due to NF. Author

N64-25590 Stanford U., Calif. Microwave Lab.
FAR-INFRARED STUDY OF OPTICAL MODES AND INDEX OF REFRACTION IN CADMIUM SULFIDE
Bente Lebech Nov. 1963 37 p refs
(Contract Nonr-225(48))
(ML-1108; AD-425626)

The region near the restrahlung frequency, in cadmium sulfide crystals, was investigated spectrometrically. The primary results show that the measured index of refraction (n ~ 2.1) in the range from 50μ to 150μ is consistent with the single resonance of the transverse optical mode at 41.5μ. It appears from the work conducted with the acoustical modes at lower frequencies that it will prove to be very difficult to achieve, in piezoelectric crystals, the high drift velocities that are required for possible interaction with the optical mode. This means that further investigations should be concentrated on polar crystals that are not piezoelectric. Appendices deal with the calculation of detectivity and with the uncertainty in the calculation of the index of refraction from experimental data. I.v.L.

N64-25603* Aerojet-General Corp., Azusa, Calif.
CATALYTIC REDUCTION OF CARBON MONOXIDE WITH HYDROGEN
S. D. Rosenberg, G. A. Guter, F. E. Miller, and G. R. Jameson Washington, D.C., NASA, Jul. 1964 69 p refs
(Contract NAS7-225)
(NASA-CR-57) OTS: $2.00

Laboratory apparatus for studying the catalytic reduction of carbon monoxide with hydrogen was designed, fabricated, and operated. Three different nickel-containing catalysts were evaluated. In addition, a determination was made of the effects on catalyst activity of several impurities in the reactant gas, and of the feasibility of achieving the reduction reaction without catalyst. Virtually quantitative reduction of carbon monoxide with hydrogen was obtained using Catalyst C-0765-1001 under these conditions: H_2/CO mole ratio, 3:1; space velocity, 1000 hr^{-1}; catalyst bed temperature, 250° C; and catalyst bed pressure, 6.1 atm. Author

N64-25786 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 88
29 May 1964 112 p refs Transl. Into ENGLISH of Selected Chinese Articles
(JPRS-24862; OTS-64-31381) OTS: $2.50

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08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propogation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-24282 Harvard U., Cambridge, Mass.
METHODS OF MEASURING SCATTERED FIELDS A Historical Survey of the Development at Harvard University
Keigo Iizuka *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 2–22 refs (See N64-24281 17-15)

For the verification of the theories developed and the study of more complicated problems that do not permit a simple mathematical analysis, various experimental techniques for measuring backscattering cross sections and the diffracted field were developed. These include standing-wave-ratio, cancellation, partial reflection, doppler-shift, and pulse-technique methods, and the application of scattering technique to field measurements. An outline is given of each of these techniques. R.T.K.

N64-24283 Conductron Corp., Ann Arbor, Mich.
FUTURE TRENDS IN RADAR CROSS SECTION MEASUREMENT
Keeve M. Siegel *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 23 (See N64-24281 17-15)

The key radar cross section problems for the future lie in measuring objects at low values of signal-to-noise ratio. New radar cross section measurement techniques and theoretical methods are needed to use short pulse answers to predict long pulse answers, and to obtain correct polarization answers when the background is a function of both the aspect of the model and the polarization being measured. R.T.K.

N64-24284 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Avionics Lab.
COMMENTS ON STATIC RADAR REFLECTIVITY MEASUREMENTS TECHNIQUES
W. F. Bahret *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 25–36 (See N64-24281 17-15)

This paper presents accumulated findings on static radar reflectivity measurements sytems and techniques that have been built up through 10 years of experience in the field. The paper concentrates on indoor measurements. It discusses types of instrumentation and model supports, with specific emphasis on anechoic chamber requirements, which have been substantiated by short pulse radar measurements, and the use of apparatus, such as tunnel antennas. The paper also dicusses model fabrication techniques, tolerances, and the use of nonmetallic coatings on models. Author

N64-24285 General Motors Corp., Santa Barbara, Calif. Microwave Section
RADAR CROSS SECTION MODEL MEASUREMENTS
W. E. Blore, R. I. Primich, R. A. Hayami, P. E. Robillard, and H. M. Musal *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 37–49 refs (See N64-24281 17-15)

The experience gained during the past 10 years in the operation of four model measurement radars in an indoor anechoic chamber is summarized. The models are three CW balanced bridges operating at frequencies of 10 Gc, 35 Gc, and 70 Gc, and a short-pulse radar operating at 35 Gc. The capabilities and uses of the latest versions of these radars are presented. R.T.K.

N64-24286 Goodrich (B. F.) Co., Shelton, Conn.
STATE-OF-THE-ART ANECHOIC BACKSCATTER RANGES
W. H. Emerson and F. P. Brownell *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 50–65 refs (See N64-24281 17-15)

The state of technological advancement in backscatter chamber development is described. Emphasis is placed on aspects such as the definition of customary means of describing backscatter chamber performance, the achievable inherent chamber cross section levels, the design techniques through which such performance can be accomplished, and the measurement techniques through which such levels can be quantitatively measured. Comparison of these performance characteristics with those of other types of ranges is included. Three modern indoor reflectivity chambers are described in detail. R.T.K.

N64-24287 MB Associates, Walnut Creek, Calif.
TRANSMISSION LINE SCATTERING RANGE
Michael J. Gans *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 66–76 refs (See N64-24281 17-15)

A new type of scattering range is described in which the radar reflection properties of objects are measured by inserting the object into a transmission line. The theoretical justification for this technique is presented from the basis of the reciprocity theorem. A theoretical comparison is then made between a specific two-wire transmission-line range and on image plane range to illustrate the increased signal and decreased spurious return provided by the transmission-line range. Its utility in the following areas is discussed; simplification of model support, positioning and orientation equipment; polarization and phase measurements; forward and bistatic cross-section measurements; frequency sweep measurements; and controlled environment measurements. Author

N64-24288 Ohio State U., Columbus Antenna Lab.
AN EFFECT OF WALL ILLUMINATION UPON MICROWAVE ANECHOIC CHAMBER PERFORMANCE
R. J. Garbacz and J. L. George *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 77–92 refs (See N64-24281 17-15)
(Contract AF 33(616)-8039)

As targets having lower and lower cross sections become of interest, demands are placed on the anechoic chamber that rarely required consideration before. One of these is target-wall

interaction, by which is meant the perturbation in the background level (due to wall illumination) upon introduction and rotation of the target in the field. Such a nonstationary background clearly is deleterious to the nulling of CW sytems and may even dictate minimum measurable cross-section criteria. An analysis of target–wall interaction is proposed that distinguishes between two types of interaction, that of the target upon the wall, and that of the wall upon the target. From the resulting expressions, recommendation can be made concerning the scattering characteristics of the target and its location. Some experimental verification of these results is given. Author

N64-24289 Lockheed Missiles and Space Co., Sunnyvale, Calif. Electromagnetics

COMPLETE RADAR CROSS-SECTION MEASUREMENTS

J. Richard Huynen *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 93–109 refs (See N64-24281 17-15)

(Contract AF 19(604)-5550)

For a target having axial symmetry, a complete set of radar cross-section data is obtained by the four polarization method, which supplies a minimum set of compatible patterns. From these patterns the invariant target parameters can be presented graphically as a null locus on a polarization chart or stored in a computer for data analysis. If the target is nonsymmetrical, complete data can be supplied only for each "cut" through the target at which measurements are performed. If the target has no "helicity" (i.e., its maximum polarization is linear) symmetric null loci for each cut can be obtained for graphical display. In either case complete scattering matrix determination is available in invariant form. This information is essential for signature data analysis and comparison of radar targets.

Author

N64-24290* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

A COMPARISON BETWEEN LONGITUDINAL BAFFLING AND TRANSVERSE FENCE FOR REDUCING RANGE GROUND SCATTERING

Alan F. Kay *In* AFSC Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 110–126 refs (See N64-24281 17-15)

(Contract NAS7-100)

Approximate equations are derived for the suppression of the ground reflected signal by longitudinal baffles and transverse fences, which have been verified by an experimental program in some cases. In a particular case these expressions (plus measured values extending data beyond the range of their validity) indicate that the best fence is superior to the best baffle and can make a substantial improvement in decreasing ground reflections. These same techniques could be used for quantitatively analyzing the performance. Author

N64-24291 Ohio State U., Columbus Antenna Lab.

AN ANALYSIS OF REFLECTION MEASURING SYSTEMS

Robert G. Kouyoumjian *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 127–145 refs (See N64-24281 17-15)

(Contract DA 36-039-SC-5506)

In measuring the radar reflectivity of an obstacle, it is frequently desired to minimize the range of measurement or maximize the back-scattered signal while maintaining prescribed limits on the departure of the incident field from a uniform plane wave at the obstacle. Although it is not possible to analyze this optimization of the measurement rigorously for the general case, the optimization is treated for an idealized measuring antenna. The results are assumed to be useful in estimating the limitations and requirements of practical reflection measuring systems. The analysis is employed also to find the approximate size of the largest model that can be measured satisfactorily with a CW reflection measuring system. Author

N64-24292 Radio Corp. of America, Moorestown, N.J. Electromagnetic Res. Lab.

MEASURING THE PHASE AND THE AMPLITUDE OF BACK-SCATTERED RADAR ENERGY ON A STATIC RANGE

Norman R. Landry *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 146–163 refs (See N64-24281 17-15)

A pulse system capable of making both phase and amplitude measurements at 1300 mc is briefly described. Following a discussion of the phase detectors that are used, some of the stability problems associated with a full-scale pulsed system are explored, with special emphasis on the effects of range background on phase measurements. Also included are discussions of (1) phase versus time-delay measurements and (2) the effect of various centers of rotation on the phase measurements from a given target. Author

N64-24293 University Coll., London (Gt. Brit.)

SURFACE CURRENTS IN THIN CONDUCTING SHEETS

P. Magoulas and P. A. Matthews *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 164–191 refs (See N64-24281 17-15)

(Sponsored by Gt. Brit. Min. of Aviation)

The measurements made have shown that the currents on rectangular sheets can be considered in two parts—the front edge currents and currents due to traveling waves on the sheet. These traveling waves can have the form of surface waves, and the theoretical work on elliptic cylinders shows the current distribution to be expected on flat sheets. From the measured values of current the effective back-scattering cross section of sheets of various lengths can be calculated.

Author

N64-24294 Conductron Corp., Ann Arbor, Mich.

CW MEASUREMENTS OF AN ECHO II BALLOON IN THE NEAR ZONE

R. K. Ritt and A. W. Wren, Jr. *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 192–204 refs (See N64-24281 17-15)

During the months of June and July 1963, radar reflectivity measurements were performed on a full-scale Echo II balloon at the main dirigible hangar, Lakehurst Naval Station. The problems connected with efficiently instrumenting for CW measurements in a near zone situation and the treatment of the data were unique and are briefly described in this paper. A description of the measurement procedure is included. R.T.K.

N64-24295 Michigan U., Ann Arbor Radiation Lab.

APPLICATION OF SURFACE FIELD MEASUREMENTS TO RADAR CROSS SECTION STUDIES

T. B. A. Senior *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 205–215 refs (See N64-24281 17-15)

Increased attention was given to the study of surface fields on selected shapes by extension of the more standard theoretical methods involving physical optics, creeping waves, etc. and by direct measurement of the currents using probes. The latter approach proved extremely valuable in these investigations and is filling a vital role in improving theoretical tools for the prediction of scattering patterns. With its aid, it is a relatively

simple matter to discover the direct effect of minor modifications to the shape of a body. The experimental facility used and some of the measurements that were made in it using this technique are described. R.T.K.

N64-24296* Ohio State U., Columbus Antenna Lab.
THE TERRAIN SCATTERING PROBLEM
Robert C. Taylor *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 216–225 refs (See N64-24281 17-15)
(Grant NsG-213-61)

The basic problem in terrain scattering work is to determine the average radar cross section per unit area (σ_0) for all types of terrain at any frequency, incidence angle, bistatic angle, polarization, and any environment. To obtain accurate values of σ_0, it was found that several important requirements in system design and techniques must be satisfied. These requirements are given and can be summarized as follows (1) The radar return from many independent samples of the same terrain must be averaged. (2) The physical characteristics of the exact area of terrain being measured must be known at any instant of time. (3) The area of the surface being measured should be small in order that controlled changes in surface structure can be made accurately. (4) The surface being measured should be homogeneous and of constant slope. (5) The data analysis should be performed at the time the measurements are being obtained. (6) The complete radar system including the antenna should be calibrated on an absolute basis. R.T.K.

N64-24297 Douglas Aircraft Co., Inc., Santa Monica, Calif. Advance Missile Technology
STUDIES IN RADAR CROSS SECTION MEASUREMENTS
P. H. Ware *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 226–232 (See N64-24281 17-15)

One of the methods of extracting information concerning the radar cross sections of bodies uses a CW radar bridge employed against a target mounted in a precision indoor microwave anechoic chamber. The equation describing the achievable sensitivity of a CW radar cross-section measurement is given. The circuit operation of a monostatic system is described. A method developed to eliminate the error caused by modification of the room reflection is presented. R.T.K.

N64-24298 Lockheed-Georgia Co., Marietta
PRECISION MEASUREMENT OF THE RADAR SCATTERING MATRIX
J. A. Webb and W. P. Allen *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 233–245 refs (See N64-24281 17-15)

Radar cross section measurement equipment is described, and some of the results of measurements made with resonant dipole chaff are given. This equipment is a quasi-monostatic, CW reflection range operating at X-band. It has one rather unusual feature, in that it utilizes electromechanical servomechanisms to drive a precision microwave phase shifter and a precision attenuator to maintain the receiver output at a null. This technique provides significant advantages over measurements made at intermediate frequencies. Author

N64-24299 Goodyear Aerospace Corp., Akron, Ohio
VERY SMALL RADAR CROSS-SECTION MEASUREMENTS AT UHF
Philip J. Willcox *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 246–256 refs (See N64-24281 17-05)

The quasi-doppler technique has been used successfully for accurate radar cross-section measurements of the order of the $10^{-5}\lambda^2$ in the UHF band. This presentation includes, in addition to the theoretical discussion of the quasi-doppler technique, the physical configuration of the test range, with particular emphasis on the determination of range parameters, and the methods employed in data reduction. A review of target support systems contains the description of a unique target mount that virtually eliminates, for certain target configurations, the effect of mount motion on the target return. Author

N64-24300 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
INDOOR RANGE DESIGN
R. J. Wohlers *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 257–286 (See N64-24281 17-15)

The successful radar cross-section measurement range requires a unique combination of excellent electronic circuitry and mechanical instrumentation and the minimization of unwanted reflections of electromagnetic radiation from the surrounding environment. Of the three basic factors involved, the most important is control of unwanted reflections, since the degree of precision of control determines the ultimate sensitivity of the entire measurement system. This paper is devoted to the design principles involved in reducing spurious responses associated with the undesired signal returns from physical environment, particularly in regard to indoor facilities. Author

N64-24301 Conductron Corp., Ann Arbor, Mich.
AN ANALYSIS OF THE POLARIZATION CAPABILITIES OF A GROUND PLANE CROSS SECTION RANGE
A. W. Wren, Jr., J. A. Green, and C. M. Mc Dowell *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 287–299 refs (See N64-24281 17-15)
(Contract AF 30(602)-2831)

The problem of measurement of circular polarization components on a ground plane range is considered. If the analysis is restricted to transverse fields, a propagation equation may be derived. This equation is examined and two methods for obtaining circular polarization measurements are deduced. The first method utilizes two orthogonal linear polarizations to obtain the linear scattering matrix, which is related to the circular scattering matrix through a unitary transformation. A second method utilizes elliptical polarization to compensate for the effect of the ground plane. With the second method, the circular components may be measured directly. Author

N64-24302 Advanced Development Labs., Inc., Nashua, N.H.
PULSED BACKSCATTER RANGE INSTRUMENTATION
A. J. Cann *In* AFSC, Griffiss AFB, N.Y., Symp. on Radar Reflectivity Meas. Apr. 1964 p 301–311 refs (See N64-24281 17-15)

Two operating systems are described, one that uses pulse integration and one that does not. The former is designed to plug into a standard antenna pattern recorder, whereas the latter is designed for high data rate. The difference in cost is striking. Design techniques are discussed, including both coherent and noncoherent integration, suppression of spurious signals, and conditions for range gating and pulse stretching without a noise figure penalty. A design example of very high sensitivity is given. Author

N64-24303 Hughes Aircraft Co., Fullerton, Calif. Radar Div.
THE HUGHES BACK SCATTER MEASUREMENT RADAR AND RECORDING EQUIPMENT
James D. Carlson *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 312–322 (See N64-24281 17-15)

Some of the problems encountered and the solutions derived during the instrumentation and operation of a short pulse, back scatter measurement range are described in detail. The emphasis in this paper is on problems common to short pulse systems in general, and on the signal processing and data recording techniques that were developed. The use of the sampled display as a vehicle for data recording has proved to be most satisfactory because it permits a number of recording methods to be used. R.T.K.

N64-24304 General Dynamics/Fort Worth, Tex.
A METHOD OF PHASE MEASUREMENT FOR PULSED RADAR SYSTEMS
Bernd Falk *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 365–374 refs (See N64-24281 17-15)

This paper contains a description of a phase measuring technique in which feedback principles are used. A feedback loop around the entire IF system is used to eliminate the errors and nonlinearities that would result from simple phase detection of the IF output. Several amplitude and phase plots of typical radar targets are presented. Application of the equipment to the direct measurement of the scattering matrix and background subtraction are briefly discussed. Author

N64-24305 Teledyne Systems Corp., Hawthorne, Calif.
RF PHASE STABILITY REQUIREMENTS FOR BALANCED CW REFLECTOMETERS
William D. Fortner *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 330–343 refs (See N64-24281 17-15)

An analysis is presented that indicates the critical dependence of the background cancellation capability of a CW reflectometer on the frequency stability of the transmitter, as well as the mechanical stability of both the microwave circuitry and the environment. The importance of using an antenna with an exceedingly low VSWR in a truly monostatic CW system is emphasized. The desirability of equalizing and minimizing (insofar as possible) the length of background signal paths and nulling signal paths is shown. The bearing of the analysis on both CW reflectometer design and CW range design is discussed briefly. Author

N64-24306 Teledyne Systems Corp., Hawthorne, Calif.
NANOSECOND PULSE SCATTERING SYSTEMS
Robert R. Hively *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 344–348 refs (See N64-24281 17-15)

A description of the pulsed-radar scattering systems is presented, with some discussion of the gated receiver and the handling of data. In addition, the low cross section model mounts are described. Author

N64-24307 Boeing Co., Wichita, Kan. Airplane Div.
THE AUTOMATIC RECORDING OF EFFECTIVE RADAR CROSS SECTION
Charles W. Matthis, Jr. *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 349–355 refs (See N64-24281 17-15)

A plotter that records the average value of radar cross section of targets at the same time that the instantaneous value is recorded was designed for use with existing radar-reflectivity range-measurement equipment. The term "average value" as used here is the integral of the square root of the target radar cross section as a function of aspect. The equipment is capable of plotting the average radar cross section over a 40 db range in amplitude in increments of 2°, 5°, and 10° target aspect. Recording the average value electronically reduces the time required for manual reduction of instantaneous data to average or median values. The plotter is particularly useful in the analyses of comparative data between model configurations. Author

N64-24308 General Dynamics/Fort Worth, Tex.
A METHOD OF STATIC RADAR CROSS SECTION MEASUREMENT FOR PULSED RADAR SYSTEMS
J. M. Murchison *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 356–364 (See N64-24281 17-15)

This paper contains a description of a unique receiving system for the measurement of radar cross section by use of a pulsed radar. The receiver incorporates a closed loop servosystem wherein the target echo and a reference signal are compared, and the amplitude of the reference signal is adjusted until it is equal to that of the echo signal. The reference signal is introduced at the IF frequency and is adjusted by use of a motor-driven waveguide "beyond-cutoff" type of attenuator. Reference signal attenuation is directly related to echo signal amplitude when the system is at null, and the shaft position of the reference attenuator therefore represents the relative radar cross section. Author

N64-24309 Naval Research Lab., Washington, D.C.
POLARIZATION ASPECTS OF RADAR REFLECTIVITY MEASUREMENTS
R. D. Tompkins *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 365–374 refs (See N64-24281 17-15)

Current interest in polarization diversity radars requires a better understanding of the target influence on polarization, coupled with an awareness of the potential of polarization diversity for target identification, signal enhancement, and clutter rejection. This paper briefly reviews the introduction of the polarization-scattering matrix into the radar range equation, discusses some of its implications and applications, and describes some measurement techniques and components that can be used to determine this matrix. Author

N64-24310 Naval Ordnance Test Station, China Lake, Calif. Michelson Laboratory
REFLECTING PROPERTIES OF AIRCRAFT MATERIALS AT 0.6943 AND 1.06 MICRONS USING PULSED LASERS
Stephen E. Barber *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 375–381 (See N64-24281 17-15)

The reflectivity of aircraft materials when illuminated by light at 0.6943μ and 1.06μ wavelength is discussed. Quantitative results of the return at different angles and the absolute reflectance are given. In addition, some work on optical cross-section measurements is discussed. Author

N64-24311 RCA Victor Co., Ltd., Montreal (Canada) RCA Victor Res. Labs.
MICROWAVE BACK-SCATTERING FROM SUPERSONIC LABORATORY PLASMA STREAMS
A. I. Carswell and M. P. Bachynski *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 382-399 refs (See N64-24281 17-15)

The scattering of electromagnetic waves by supersonic

plasma streams has been studied in the laboratory in a radio-frequency, low-density (0.1 to 10 torr static pressure) plasma tunnel. Measurements have been concerned with the aspect dependence of microwave back scattering from cylindrical supersonic plasma flow fields and with the back scattering of microwaves from turbulent supersonic plasma streams. Author

N64-24312 Lincoln Lab., Mass. Inst. of Tech., Lexington
THE SPIN-DROP METHOD OF MEASURING MODEL RADAR CROSS SECTION
Peter C. Fritsch *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 400–409 (See N64-24281 17-15)
(Sponsored by AF)

The common and time-honored method of measuring radar cross section on static ranges involves the positioning of the test object ("model") by means of some mechanical support. These supports are apt to have an undesirable effect on the test results, for they tend to modify both the incident field and the reflected field. All of the spin-drop experiments were carried out using a K_a band CW radar. While no nearby supports now interfere with the scattering from the model, other more distant objects, such as the walls of the anechoic chamber, continue to obtrude as before. R.T.K.

N64-24313 Lincoln Lab., Mass. Inst. of Tech., Lexington
A METHOD OF MEASURING SMALL RADAR CROSS SECTIONS BY DIGITAL VECTOR-FIELD SUBTRACTION
F. E. Heart and P. C. Fritsch *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 410–414 (See N64-24281 17-15)
(Sponsored by AF)

If the coupling between the target support structures and the target has negligible effect on the cross section of the target, then it should be feasible to measure the amplitude and phase of the return of the supporting column, and separately that of column plus target, subtract the fields, and thereby obtain what would be the return of the target in the absence of a supporting structure. With this technique, the necessity of reducing the cross section of the supporting structure is somewhat decreased, allowing the measurement of larger and heavier low cross section targets. The foregoing idea was implemented; as a result, a substantial reduction in the interference contribution of the support structure was obtained. This process provides a substantial increase in the ability to measure true target phase and amplitude as a function of azimuth. A secondary benefit of this approach is the convenience of digital processing to obtain output presentation of the data in more useful forms. R.T.K.

N64-24314 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
RADAR CROSS-SECTION MODEL FABRICATION AT CORNELL AERONAUTICAL LABORATORY
John E. Hopkins *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 415–418 (See N64-24281 17-15)

Problems and techniques of model fabrication are discussed. The need for lightweight models to permit using supports with small radar reflection is noted. The merits of wooden models are mentioned, and precautions that must be taken in working with these models are presented. Author

N64-24315 Hughes Aircraft Co., Fullerton, Calif. Radar Div.
METAL-SPRAYED FIBERGLASS RADAR TARGET MODELS
Forest M. Hudson *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 419–425 (See N64-24281 17-15)

The five targets required for the program were successfully fabricated at a relatively low cost with a metal-sprayed fiberglas process described in this paper. A table is including showing the targets made and the production cost of each. R.T.K.

N64-24316 Ohio State U., Columbus Antenna Lab.
ANTENNA SCATTERING MEASUREMENTS
D. L. Moffatt *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 426–439 refs (See N64-24281 17-15)
(Contract AF 33(616)-8039)

A description is given of systematic measurement procedures for the evaluation of the scattering properties of targets that have one or more pairs of terminals with associated loads. The interpretation of model measurements is described, but the measurement procedures given are equally applicable to modeled or full-scale targets. The case discussed is that of a scatterer with a single pair of terminals located on a transmission line supporting a single propagating mode. R.T.K.

N64-24317 Ohio State U., Columbus Antenna Lab.
THE EFFECT OF FINITE CONDUCTIVITY ON RADAR CROSS SECTIONS
Leon Peters, Jr. *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 440–455 refs (See N64-24281 17-15)
(Contract AF 33(616)-8039)

The radar cross section of many bodies is due to a specular reflection and a creeping-wave component. A first-order approximation consists of simply multiplying the radar cross section of the perfectly conducting body by the square of the Fresnel reflection coefficient. This is reasonably valid for many cases. This approximation is not valid if the creeping wave is significantly attenuated. A means of determining the absorption attenuation factor has been given and has been shown to yield accurate radar cross section values for the maxima and minima of the sphere with finite conductivity. The application of the modified geometrical optics method for dielectric bodies with small conductivity is discussed. The effect of loss on the radar cross section due to traveling-wave modes is treated. Author

N64-24319 Stanford Research Inst., Menlo Park, Calif.
NANOSECOND PULSE SCATTERING FROM EXTENDED LABORATORY TARGETS
H. S. Rothman, H. Guthart, and T. Morita *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 475–502 refs (See N64-24281 17-15)
(Contract ARPA SD-103; ARPA Order 281–62)

Through the use of an X-band (9.4 Gc) radar with a pulse width of one nanosecond, pulse broadening and interference effects in the reflected electromagnetic signal have been studied. This paper is concerned with scattering from targets of simple configuration such as an array of dipole scatterers as well as a metal cylinder. The backscatter from a simplified ionized target in the form of an extended laminar plasma column has also been investigated, and the measured results are compared with calculations based on a homogeneous model approximation. The initial diagnosis of the ionized constituents of a turbulent flame has been completed, using an electrostatic ion probe and a microwave electron probe; the results are presented. Author

N64-24320 Michigan U., Ann Arbor Radiation Lab.
SURFACE ROUGHNESS AND TOLERANCES IN MODEL SCATTERING EXPERIMENTS
T. B. A. Senior *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 503–520 refs (See N64-24281 17-15)

The theoretical and experimental studies described strongly suggest that a high degree of surface finish is not essential for model scattering work. The investigations were limited to specific shapes (cone-spheres) and roughnesses, but it is believed that the cases chosen were of sufficient generality to allow a definitive conclusion to be reached. In none of these cases was a surface finish better than $10^{-3}\lambda$ required. R.T.K.

N64-24321 Michigan U., Ann Arbor Radiation Lab.
ESTIMATES OF THE 'VOLUME' RETURN FROM STYROFOAM
T. B. A. Senior and E. F. Knott *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 521–526 ref (See N64-24281 17-15)
(Contract AF 30(602)-2831)

In an attempt to measure the electrical properties of styrofoam, including the volume return, an experiment was undertaken in which the backscattering from a sequence of shaped blocks was determined at a series of closely spaced frequencies in the X-band range. From the data obtained, having the dimensions of the block, the permittivity and loss factor of the material could be deduced. Typical results of the scattering from a styrofoam block are included. R.T.K.

N64-24322 Michigan U., Ann Arbor Radiation Lab.
THE NEAR FIELD OF A STYROFOAM CYLINDER
T. B. A. Senior and E. F. Knott *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 527–541 (See N64-24281 17-15)
(Contract AF 30(602)-2831)

A study was undertaken to explain an unusual scattering effect observed when a sphere was mounted on a long styrofoam cradle. These effects are of major importance in the design of target support pedestals, and an understanding of their origin is essential. Several possible mechanisms were examined, and it was concluded that only an amplitude and/or phase disturbance, confined to the immediate vicinity of the suface and increasing with the length of styrofoam over which the field has traveled, could suffice to explain the observations. Direct measurement of the amplitude and phase of the field near a styrofoam cylinder confirmed the existence of a disturbance. The details of the results of these experiments are presented. R.T.K.

N64-24323 Thomas (A.S.), Inc., Westwood, Mass.
MODELING OF RAM-COVERED COMPLEX BODIES
A. S. Thomas *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 542–548 refs (See N64-24281 17-15)

Scaling of complex bodies covered with lossy materials may be possible with materials having parameters somewhat different from those used on the full-scale model, provided that the experimenter can immerse the model in a medium with permittivity greater than free space and adjust the permittivity of the materials on the model by the same factor over that of the full-scale model. Author

N64-24400 Federal Aviation Agency, Atlantic City, N.J. Research Div.
MICROWAVE RADIATION HAZARD TO AIRCRAFT TRANSITING RADIO AND RADAR BEAMS Final Report
John J. Kulik Dec. 1963 42 p refs
(RD-64-1; AD-435491)

A hazard to aircraft transiting high-power density radio and radar beams exists unless appropriate safety measures are practiced. Susceptibilities of humans, aircraft fuel vapors, avionics, and electroexplosive devices to microwave radiation indicate limits of power densities of electromagnetic radiation to which aircraft may be safely exposed. From a study of the literature and analyses conducted herein, it is concluded that aircraft not carrying electroexplosive devices may be safely exposed to average power densities of 10 mw/cm^2 or less. Aircraft carrying electroexplosive devices may be safely exposed, under some conditions, to power densities of 1 mw/cm^2. This report contains charts, and procedures for using them, which give distances along the antenna beam axis at which the aforementioned limits are reached. It is recommended that experiments be undertaken to verify analyses in this report and that progress of the military services on electroexplosive devices be monitored to assure the earliest possible implementation of less restrictive limits. Author

N64-24488 Joint Publications Research Service, Washington, D.C.
TRANSMISSION OF INFORMATION BY EXTRATERRESTIAL CIVILIZATIONS
N. S. Kardeshev 30 Jun. 1964 10 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 41, no. 2, Mar.–Apr. 1964 p 282–287
(JPRS-25307; TT-64-31588) OTS: $0.50

The unidirectional nature of cosmic rays is determined by the long duration of signal propagation. To insure the probability and reliability of reception by unknown peoples, isotropic radiation is required. The optimal spectrum of the signal needed to provide for transmission of the maximum amount of information, in the presence of quantum fluctuation and a background of cosmic radio waves, is calculated. R.T.K.

N64-24509 Joint Publications Research Service, Washington, D.C.
CRITERIA FOR THE EVALUATION OF RADIOTELEMETRY SYSTEMS WITH TIME SHARING OF CHANNELS
L. I. Dovbeta *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 18–28 refs (See N64-24506 17-09) OTS: $3.50

This paper presents an analysis of the existing criteria for the evaluation of radiotelemetry systems using time sharing of channels. A more precise method of calculation of these criteria is given. New evaluation criteria are introduced that take account of the overall reliability and effectiveness of operation of the system. N.E.A.

N64-24540 Joint Publications Research Service, Washington, D.C.
NOISEPROOF TRANSMISSION OF REMOTE-CONTROL COMMANDS BY USING DUPLICATION AND STORAGING
B. Ya. Sovetov *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 33–41 refs (See N64-24536 17-09) OTS: $3.50

Noiseproof transmission of remote-control commands by the use of duplication and storage was investigated. Results indicate the following: (1) The application of the principle of duplication serves to reduce the probability of a protective nonresponse in the system's operation and increases the probability of the message becoming transformed, when a random pulse interference acts upon error detecting. (2) It is expedient

to employ the principle of storage in order to reduce the probability of transformation when using duplication. The application of storage makes it possible to duplicate codes, even when they are arranged for all combinations (3) It is advisable to use the principle of storage together with a correcting code in order to reduce the time spent in transmitting a message. I.v.L.

N64-24587* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
DATA REPORT ON WHISTLERS OBSERVED BY VANGUARD III (1959 η..1)
Ivan R. Shapiro, John D. Stolarik, and James P. Heppner Washington, NASA, Jul. 1964 31 p refs
(NASA-TN-D-2313) OTS: $1.00

A study of 1,200 whistlers observed in several longitudinal zones between ± 33.5° geographic latitude and in the altitude interval from 510 to 3,753 km shows an increase of the average rate of occurrence of whistlers with increasing magnetic activity, peaking at KP = 5. Rising tone VLF emissions and diffuse whistlers were nearly always observed during periods of magnetic disturbance. A complete list of whistler observations and their dispersions is given. Author

N64-24670 Royal Inst. of Tech., Stockholm (Sweden).
A DISCONTINUITY PROBLEM IN A CIRCULAR WAVEGUIDE CONTAINING TWO DIELECTRICS
B. Enander *In its* Interaction between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 23–41 refs (See N64-24668 17-09)

In the study and application of plasma waveguides it is important to know how energy is transferred between conventional waveguides and plasma waveguides. An attempt to obtain approximate solutions of this problem by a variational method has been made (KALMYKOVA 1961). In this paper a waveguide structure is investigated for which exact solutions can be obtained. The problem is formulated and solved for a waveguide that, for values of the dielectric constant less than one, represents a waveguide containing a cool, homogeneous plasma. Author

N64-24671 Royal Inst. of Tech., Stockholm (Sweden)
INVESTIGATION OF BACKWARD WAVE MODES IN PLASMA WAVEGUIDES
L. Alfredsson *In its* Interaction between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 42–62 refs (See N64-24668 17-09)

In recent years, Trivelpiece, Clarricoats, Napoli and Swartz, Oliner, and Agdur and Enander, studied wave propagation in inhomogeneous waveguides. Using ferrites, plasmas, and ordinary dielectrics, it is possible to achieve propagating backward-wave modes in nonperiodic waveguides. This paper describes the surface-wave dipole modes in the plasma waveguide systems. Some experiments were performed that generally show good agreement with the theory. Author

N64-24712 Air Force Systems Command, Griffiss AFB, N.Y. Rome Air Development Center
SYMPOSIUM ON RADAR REFLECTIVITY MEASUREMENTS
Apr. 1964 371 p refs Papers Presented at Symp. on Radar Reflectivity Meas., Lincoln Lab., (MIT), Lexington 2–4 Jun. 1964
(RADC-TDR-64-25, Vol. II; AD-601365)

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24. AERONUTRONIC MICROWAVE REFLECTIVITY FACILITY Harold G. Collins (Aeronutronic) p 233–239 refs (See N64-24736 17-10)

25. MILLIMETRE WAVE SHORT PULSE RADARS FOR INDOOR ECHOING AREA MEASUREMENTS L. A. Cram (E. M. I., Ltd.) p 240–243 (See N64-24737 17-08)

26. THE LINCOLN LABORATORY MODEL BACKSCATTER RANGE P. C. Fritsch, D. F. Sedivec, and A. J. Yakutis (Lincoln Lab.) p 244–249 (See N64-24738 17-08)

27. LOCKHEED MISSILES AND SPACE COMPANY SCATTERING RANGE CAPABILITIES N. J. Gamara (Lockheed Missiles and Space Co., Sunnyvale) p 250–251 (See N64-24739 17-08)

28. EXPERIMENTAL REFLECTIVITY FACILITIES Robert J. Garbacz (Ohio State U.) p 252–265 refs (See N64-24740 17-10)

29. SCATTERING RANGE—THE BOEING COMPANY AEROSPACE DIVISION W. P. Hansen, Jr. (Boeing Co.) p 266–269 ref (See N64-24741 17-10)

30. RCA DYNAMIC BACKSCATTER TESTING RANGE M. H. Hellman and J. M. Jarema (RCA, Burlington) p 270–273 (See N64-24742 17-10)

31. OUTDOOR PULSED RADAR REFLECTIVITY RANGE E. Honer and W. D. Fortner (Tekdyne Systems Corp.) p 274–285 refs (See N64-24743 17-10)

32. CROSS-SECTION RANGE RADARS AT CORNELL AERONAUTICAL LABORATORY E. Hopkins (Cornell Aeron. Lab.) p 286–294 (See N64-24744 17-08)

33. AN INDOOR RADAR SCATTERING RANGE E. F. Knott (Michigan U.) p 295–298 ref (See N64-24745 17-08)

34. STATIC RADAR REFLECTIVITY MEASUREMENT FACILITIES AT RADIATION INCORPORATED J. E. Landfried and W. L. Williamson (Radiation, Inc.) p 299–302 (See N64-24746 17-10)

35. A RADAR BACKSCATTER RANGE FOR MEASUREMENT OF LARGE MODELS Wesley G. Louie and Charles W. Matthis, Jr. (Boeing Co., Wichita) p 303–305 (See N64-24747 17-10)

36. AN ULTRA-HIGH FREQUENCY REFLECTION MEASURING SYSTEM Siegfried Mikuteit (Ohio State U.) p 306–313 refs (See N64-24748 17-08)

37. RADAR ECHOING AREA RANGES AT ROYAL AIRCRAFT ESTABLISHMENT J. G. W. Miller and J. Edwards (R. A. E.) p 314–320 (See N64-24749 17-08)

38. RADAR TARGET SCATTER (RATSCAT) SITE Donald Montana (RADC) p 321–329 (See N64-24750 17-10)

39. INVESTIGATION TO DESIGN A METHOD FOR THE ANALYSIS OF RADAR CROSS-SECTION MEASUREMENT DATA M. L. Parish (Martin Co., Denver) p 330–333 (See N64-24751 17-08)

40. AN ANECHOIC CHAMBER FOR MEASUREMENT OF BACKSCATTER AMPLITUDE AND PHASE AT MULTIPLE POLARIZATIONS R. W. Roop and S. M. Sherman (RCA, Moorestown) p 334–340 (See N64-24752 17-08)

41. THE SCALE GROUND PLANE RANGE R. A. Ross (Cornell Aeron. Lab.) p 341–353 refs (See N64-24753 17-08)

42. U. S. NAVAL MISSILE CENTER RADAR REFLECTIVITY MEASUREMENT FACILITIES AND TECHNIQUES John K. Rozendal (Naval Missile Center) p 354–358 (See N64-24754 17-10)

43. CONDUCTRON CORPORATION'S RADAR CROSS SECTION RANGE A. W. Wren, Jr. (Conductron Corp.) p 359–362 (See N64-24755 17-10)

44. DESCRIPTION AND OPERATION CHARACTERISTICS OF A SHORT-PULSE, OBLIQUE RADAR CROSS-SECTION RANGE Malcoln Yaffe (G. E. Co., Philadelphia) p 363–372 (See N64-24756 17-10)

N64-24713 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
RADAR CROSS-SECTION DATA GENERATION AND RECORDING IN THE CORNELL AERONAUTICAL LABORATORY RANGES
Robert V. Gallagher *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 1–4 (See N64-24712 17-08)

The data recording and handling techniques used with the four radar cross-section ranges are discussed, and associated equipment is described. Author

N64-24714 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
ANALYTICAL INVESTIGATION OF NEAR-ZONE/FAR ZONE CRITERIA
Lee R. Hendrick *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 5–19 refs (See N64-24712 17-08)

An analytical investigation of the effects of reduction of antenna-to-target distance is performed, using simplified targets composed of point scatterers. Also, the effects of restricting the antenna beamwidth are studied. Author

N64-24715 Goodyear Aerospace Corp., Akron, Ohio Antenna and Microwave Lab.
SOME FACTORS AFFECTING THE ACCURACY OF GROUND-PLANE MEASUREMENTS
J. C. Huber, Jr. and G. M. Hazlip *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 20–32 refs (See N64-24712 17-08)

Three factors affecting the accuracy of ground-plane cross-section measurements are: (1) the fields at the target and at the receive antenna, (2) the effect of the target on the background, and (3) the correct use of a sphere as a reference, including the minimization of sphere–ground interaction. These factors are considered analytically. Data on background changes due to target taken on a quasi-doppler range are presented. Errors due to these causes are found to be significant fractions of a decibel. Author

N64-24716 Army Missile Command, Huntsville, Ala. Advanced Systems Lab.
RADAR REFLECTIVITY MEASUREMENT DATA FORMAT STANDARDS
Stephen L. Johnston *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 33–38 (See N64-24712 17-08)

Although certain data types are more prevalent than others, at present there are no universally used standards of radar reflectivity measurement data format. Advantages of standards are discussed, along with considerations for possible standards. Author

N64-24717 Battelle Memorial Inst., Columbus, Ohio
RADAR MEASUREMENT STANDARDIZATIONS NEEDED FOR SIMULATION STUDIES
C. Krichbaum *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 39–49 refs (See N64-24712 17-08)

The purpose of this paper is to show some inadequacies of past and present radar-range measurements for use in simulation studies and to show some changes needed to meet the requirements of users of radar-range data in simulation studies. The scope of some of these programs is defined in terms of types of calculations, required inputs, and desired outputs. Factors shown to affect the types of data needed include effects of asymmetries, polarization effects, and the need for complete scattering matrix measurement. The effect of measurement error upon choice of measurement parameters for symmetric targets is discussed. Author

N64-24718 Ohio State U., Columbus Antenna Lab.
A NEW MINIMUM RANGE CRITERION FOR MEASUREMENT OF RADAR CROSS SECTIONS
Leon Peters, Jr. *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 50–61 (See N64-24712 17-08)
(Contract AF 19(604)-7270)

This paper considers the assumption that the minimum range is $2D^2/\lambda$ where D is the dimension of the target. In order to obtain a proper phase distribution over the target this assumes the radar range antenna to be a point source. A new picture is developed from the point of view of geometrical optics. The antenna with a uniform phase distribution is approached as a limiting case of a point source radiator. This point source is located so that the minimum range criterion is reduced. A new effective minimum range is given, based on this geometrical optics limit. This new approach is supported by Fresnel zone computations of the phase of a uniform aperture distribution. Author

N64-24719 Radio Corp. of America, Moorestown, N.J. Electromagnetic Research Lab.
EXPERIENCE WITH CALIBRATION TARGETS AND TECHNIQUES AT RCA-ERL
R. Sigler *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 62–66 refs (See N64-24712 17-08)

The following is a summary of calibration references and procedures tested and used by the ERL for radar measurement purposes. Several reference target configurations are briefly described. The advantages and disadvantages of spheres as primary standards are presented. Author

N64-24720 Conductron Corp., Ann Arbor, Mich.
COMPARISON OF RADAR CROSS SECTION SIGNATURES
D. R. Brown and A. L. Maffett *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 67–80 (See N64-24712 17-08)

Effective comparisons of radar cross section signatures are usually made in terms of some signature attribute to be agreed upon in advance or dictated by the system of which the signatures form a part. A technique is developed, particularly applicable to graphical data, for constructing redistributed functions for the data on the basis of which comparisons can be more easily and directly made. The redistributed functions can also be conveniently applied to obtain from a signature almost any attribute of an "average" nature. These results are used to compare static and dynamic radar cross section signatures. Author

N64-24721 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
USE OF RADAR CROSS SECTION DATA IN MILITARY SYSTEMS ANALYSIS
H. A. Ecker *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 81–92 refs (See N64-24712 17-08)

Three main areas are discussed in this paper. The first concerns the way in which radar cross section measurement data are being used to perform military systems analyses. The second area covers a discussion of the shortcomings in radar reflectivity data that have limited studies in the past. Finally, the type and form of radar cross section data that will be required in the future are discussed. Author

N64-24722 Michigan U., Ann Arbor Radiation Lab.
TARGET RECOGNITION AND DISCRIMINATION
R. F. Goodrich, O. Ruehr, Z. Akcasu, and G. Rabson *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 93–118 (See N64-24712 17-08)
(Contract DA-36-039-SC-90733)

Since it is possible to make a previous determination of the response of various classes of targets as a function of frequency, it is possible to devise frequency filters that will accept only those characteristic of the target under search. The type of filter considered is one designed so as to vary from an inverse filter to a matched filter. Since the inverse filter is best for range discrimination, and the matched filter is best for noise suppression, a "mixed" filter is used, leaving the specific choice of the parameter to the requirements of the system. This recognition scheme depends critically on the prior classification and characterization of the targets. Author

N64-24723 Teledyne Systems Corp., Hawthorne, Calif.
SUB-NANOSECOND PULSE METHODS OF RADAR CROSS SECTION MEASUREMENT
Robert R. Hively *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 119–128 refs (See N64-24712 17-08)

A description of the history of development, and the present and projected uses of sub-nanosecond pulses in radar cross section measurements is presented. Of particular interest is the use of sub-nanosecond pulses as a diagnostic tool for radar cross section reduction and for exact measurement of creeping waves. Author

N64-24724 Lockheed Missiles and Space Co., Sunnyvale, Calif.
CONTOUR CHARTS FOR RADAR CROSS-SECTION ANALYSES
Daniel Levine *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 129–152 refs (See N64-24712 17-08)

Contour charts of radar cross section provide a useful form of data reduction for the set of pattern cuts required to measure the return at all angles in space. The best configuration of the coordinate grid on which the data are plotted depends upon symmetries in the shape of the test model. Several equal-area cartographic projections are decribed, and illustrations are given of the type of body for which each projection is best suited. In addition, a new projection based on the geometry of stabilized vehicles above the spherical earth is presented, which is especially pertinent for satellite measurements. Author

N64-24725 Radiation, Inc., Melbourne, Fla.
GEOMETRY AND INSTRUMENTATION CONSIDERATIONS FOR DYNAMIC REFLECTIVITY MEASUREMENTS
E. G. Meyer and C. L. Mohre *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 153–165 (See N64-24712 17-08)

Dynamic reflectivity measurements require precise information about the position and attitude of the airframe relative to the illuminating radar. Four parameters of the airframe—heading, roll, pitch, and altitude—and two parameters derived from a radar tracking the airframe—azimuth and range—will serve to completely define the aspect of the airframe relative to the illuminating radar. Dynamic reflectivity measurements can be made of the airframe, using either the tracking radar or radars in other frequency bands slaved to the tracking radar by making measurements of returned signal amplitude in a nongain controlled receiving channel. The relations between measured parameters and target aspect are derived. Considerations affecting data sampling rates are discussed along with instrumentation and data reduction configurations. The measurement and data reduction techniques and equipment are also applicable to dynamic antenna testing of antennas mounted on an airframe. Author

N64-24726 Naval Research Lab., Washington, D.C.
A MULTI-BAND, POLARIZATION DIVERSITY SYSTEM FOR DYNAMIC RADAR CROSS-SECTION STUDIES
I. D. Olin and F. D. Queen *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 166–176 refs (See N64-24712 17-08)

A high-power, pulsed-radar system specially designed for cross-section measurements of full-size targets, under dynamic conditions, has been completed and placed into operation. The system permits simultaneous measurement and recording at L, S, and X-band frequencies on a pulse-to-pulse basis. The system, completely trailer mounted, uses magnetron transmitters pulsed together and an antenna assembly mounted to a single-servo controlled director. Operation at L and S bands may be with either vertical or horizontal polarization. At X-band, transmission may be selected at either vertical, horizontal, right-circular, or left-circular polarization, while receiving components of all four, simultaneously. The system is currently being employed in studying a variety of target characteristics germane to radar cross-section and target identification. Author

N64-24727 Avco Corp., Wilmington, Mass. Research and Advanced Development Div.
A NEW METHOD OF CORRELATION OF DOWN-RANGE RADAR MEASUREMENTS WITH STATIC RADAR CROSS SECTION MEASUREMENTS
N. E. Pederson, H. I. Halsey, J. F. Torrey, and J. B. Clemente *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 177–186 (See N64-24712 17-08)

Methods were devised whereby reentry vehicle dynamics during midcourse and early reentry are directly correlated with static radar cross-section returns of the vehicle. At present, only scale-model measurements are used. Strong emphasis is placed on the statistical methods employed to obtain useful information. High-speed computer techniques are used to provide this information in a short time and in a format easily interpreted. The procedures require the knowledge of radar cross section as a function of aspect and polarization angles, the various aerodynamic coefficients and dynamical constants for the vehicle, the statistics of the various thrust mechanisms, and the location and polarization of the radar. Author

N64-24728 General Dynamics/Fort Worth, Tex.
INSTRUMENTATION OF A TRACKING RADAR FOR DIRECT RECORDING OF RADAR CROSS SECTION
Donald C. Watson *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 187–196 (See N64-24712 17-08)

This paper contains a description of a technique for obtaining a capability of real time, dynamic radar cross-section measurement by adding an attachment to a tracking radar. The AN/MPS-9 tracking radar is used as an example to show the adaptability of the attachment. The dynamic measurement instrumentation is shown in block diagram form, and a functional description of each block is presented in terms of signal flow. A procedure for calibration and operation is described for use with the instrumentation to enable direct calibration through the measurement of the backscatter from a sphere. Several of the possible error sources are discussed, and a brief analysis of instrumentation error is presented. Author

N64-24729 California U., Berkeley Electronics Research Lab.
THE UNIVERSITY OF CALIFORNIA IMAGE-PLANE REFLECTIVITY RANGE
D. J. Angelakos and F. D. Clapp *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 197–200 (See N64-24712 17-08)

The scheme used in reflectivity measurements consists of an image-plane range in conjunction with a magic-tee circuit. The mechanical and electrical characteristics of the range are described. Author

N64-24730 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Avionics Lab.
AVIONICS LABORATORY RADAR CROSS SECTION MEASUREMENTS FACILITY
W. F. Bahret *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 201–202 (See N64-24712 17-08)

The building has an unobstructed floor space 100 × 200 ft and a parabolic arched roof whose peak is 90 ft above the floor. The area used for cross-section measurements is bounded by movable panels of radar absorber material and is 65 × 30 ft. The bulk of instrumentation is conventional CW apparatus. Because of antenna size, all systems except the X-band use a single antenna with both a hybrid tee junction and a tunable load, for nulling the received signal in the absence of a target. Included in the facility is a short pulse, 10-nanosecond X-band radar. G.D.B.

N64-24731 Air Force Cambridge Research Labs., Bedford, Mass.
RADAR CROSS SECTION MEASURING EQUIPMENT AND RANGE
P. Blacksmith and R. Mack *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 203–207 (See N64-24712 17-08)

The model radar cross section measuring system is used for making dynamic measurements of radar reflection characteristics of targets, such as missile configurations and aircraft. It can be used for measuring either monostatic or bistatic cross sections. G.D.B.

N64-24732 Hughes Aircraft Co., Fullerton, Calif. Radar Div.

THE HUGHES BACK SCATTER MEASUREMENT RANGE

R. E. Boucher and Don E. Ludwig *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 208–217 (See N64-24712 17-08)

An oblique-type range layout is used in conjunction with dielectric line test object suspension and positioning. The measurement radar antenna-test object separation (500 feet) is sufficient to permit valid radar cross-section measurements of full-scale test objects. Excellent short-pulse measurement sensitivity has been maintained with this antenna-test object range separation. Since the majority of the background interference return can be gated out at the radar receiver when performing short pulse back scatter measurements, a low background interference level is obtained that is invariant with environmental conditions. At C-band, the measurement sensitivity is currently a −50-dbsm (decibels below 1 square meter) cross section with a 10-db signal-to-noise ratio. The C-band interference background level is below the return from a −60 dbsm radar cross section target. Range calibration tests that were performed are described, and examples are given of the measurement data obtained from several types of test objects. Author

N64-24733 RCA Victor Co., Ltd., Montreal (Canada) RCA Victor Research Labs.

RANGE FACILITIES FOR MEASURING RADAR CROSS SECTIONS OF LOW DENSITY SUPERSONIC PLASMA STREAMS

Allan I. Carswell *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 218–222 refs (See N64-24712 17-08)

In the present system, a six-arm cross of standard pyrex tubing is used for the test section, to provide a large and easily accessible test region. The high-frequency RF field used for the plasma generation is capacitively coupled to the gas stream with two external cylindrical electrodes both located upstream from a protruding nozzle. The system is illustrated by schematic diagrams. G.D.B.

N64-24737 Electric and Musical Industries, Ltd., Hayes (Gt. Brit.)

MILLIMETRE WAVE SHORT PULSE RADARS FOR INDOOR ECHOING AREA MEASUREMENTS

L. A. Cram *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 240–243 (See N64-24712 17-08)

(Sponsored by Min. of Aviation)

A brief description is given of equipment used for measuring radar echoing area by modeling methods. Pulse radars at 8.6 mm and at 4.3 mm are used indoors to measure echoes from models up to 10 ft in extent. Nylon strings support the model from a gantry structure by means of which the reflector may be rotated. Bistatic and monostatic measurements are possible. Calibration is against a sphere. Sensitivity is to 1/30 square wavelengths at 8.6 mm and 6 square wavelengths at 4.3 mm. Author

N64-24738 Lincoln Lab., Mass. Inst. of Tech., Lexington

THE LINCOLN LABORATORY MODEL BACKSCATTER RANGE

P. C. Fritsch, D. F. Sedivec, and A. J. Yakutis *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 244–249 (See N64-24712 17-08)

(Sponsored by AF)

Two major equpments, viz, a K_a-band CW radar and a K_u-band short-pulse radar, are housed in a room a little over 100 feet long. Special emphasis has been given to the development of precise methods of measuring very low values of radar cross section. Author

N64-24739 Lockheed Missiles and Space Co., Sunnyvale, Calif. Electromagnetics Branch

LOCKHEED MISSILES AND SPACE COMPANY SCATTERING RANGE CAPABILITIES

N. J. Gamara *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 250–251 (See N64-24712 17-08)

These two tables give scattering range capabilities for the outdoor range and for the anechoic chamber for all frequency bands concerned and for CW and pulse, giving transmitter power values at a transmitter power stability of 0.50 db/hr, and other pertinent data. G.D.B.

N64-24744 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

CROSS-SECTION RANGE RADARS AT CORNELL AERONAUTICAL LABORATORY

John E. Hopkins *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 286–294 (See N64-24712 17-08)

Four separate radars are used for radar cross-section measurement. These are distinguished by frequency and type, as follows: K_a-band pulsed radar, K_a-band CW radar, X-band CW radar, and X-band FM/CW high resolution radar. The principal features and capabilities of each of these radars are described. Author

N64-24745 Michigan U., Ann Arbor Radiation Lab.

AN INDOOR RADAR SCATTERING RANGE

E. F. Knott *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 295–298 ref (See N64-24712 17-08)

The anechoic chamber is part of a room 28 ft wide, 15 ft high, and 148 ft long. The walls of the room are covered with 2-in.-thick hairflex absorber. The microwave circuitry is exclusively a balanced bridge CW system employing a hybrid tee. Phase-locked klystrons and crystal-excited multiplier chains are used as microwave sources from L- through S-band. The other features of the indoor radar scattering range are also discussed. G.D.B.

N64-24748 Ohio State U., Columbus Antenna Lab.

AN ULTRA-HIGH FREQUENCY REFLECTION MEASURING SYSTEM

Siegfried Mikuteit *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 306–313 refs (See N64-24712 17-01)

(Contract AF 33(657)-10386)

For the study of echo-area control a CW radar facility operating at a frequency of 422 mc with a variable range from 30 to 103 ft and the capability to vary the polarization of the transmitting and receiving antennas continuously through 90° has been constructed and calibrated. The system has a linear dynamic range of 50 db with accurate calibration possible over a range of 80 db if necessary. Presently, the minimum measurable cross section of a target supported on a steel tower at a range of 48 ft is one square wavelength with an accuracy of

one db. The null depth is about 75 db below a direct connection. Closed system stability evaluated over an 8-hour period is ± 1 kc, resulting in a sufficiently small phase error in the nulling circuit so as not to affect the null depth significantly. Measurements with flat plates and a hybrid T-bar slot antennafier agree with theoretical values to within the system accuracy. Author

N64-24749 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
RADAR ECHOING AREA RANGES AT ROYAL AIRCRAFT ESTABLISHMENT
J. G. W. Miller and J. Edwards *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 314–320 (See N64-24712 17-08)

This paper describes the layout and limitations of two outdoor radar model ranges. These work at frequencies in S- and X-bands. Both are capable of measuring very small radar echoes (10^{-4} sq m at S-band and 10^{-5} m at X-band), and can accommodate models up to 300 lb in weight and 10 ft in length. Echoes can be measured to within about ±1/2 db, and aspects to within ±1°. Author

N64-24751 Martin Co., Denver, Colo.
INVESTIGATION TO DESIGN A METHOD FOR THE ANALYSIS OF RADAR CROSS-SECTION MEASUREMENT DATA
M. L. Parish *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 330–333 (See N64-24712 17-08)

This new microwave anechoic chamber will produce reflection for pattern measurements in excess of 70 db down at worst aspect angles and an equivalent radar cross section of approximately 1×10^{-6} m^2 at 25 ft. The backscatter range is fully equipped for both bistatic and monostatic measurements at X-band. Tests are being run to determine errors involved in various methods of model suspension and rotation. G.D.B.

N64-24752 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
AN ANECHOIC CHAMBER FOR MEASUREMENT OF BACKSCATTER AMPLITUDE AND PHASE AT MULTIPLE POLARIZATIONS
R. W. Roop and S. M. Sherman *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 334–340 (See N64-24712 17-08)

In making target backscatter measurements, it is sufficient for many applications to measure only backscatter amplitude (or radar cross section). For other applications the requirements are more sophisticated, and the complete scattering matrix, including amplitudes and phases, must be measured. Models of radar targets are designed by scaling the body dimensions to the wavelength used and are mounted on a pedestal in the X-band anechoic chamber. The target is illuminated alternately with orthogonally polarized waves by means of a 400-cps switch that directs the RF energy into one of two possible microwave channels. By means of a synchronized set of switches in the receiving system, the amplitude and phase of two orthogonal polarizations can be measured and recorded during each period of transmission. As a result, the amplitude and phase of each possible combination of polarizations in the scattering matrix of the target can be obtained experimentally as a function of the aspect angle. The phase measured is not merely of one polarization relative to another, but of each polarization relative to a fixed reference phase. Author

N64-24753 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE SCALE GROUND PLANE RANGE
R. A. Ross *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 341–353 refs (See N64-24712 17-08)

This paper reports on a simulation of the full-scale ground plane range (Rat Scat) being built at White Sands Proving Grounds. Prove-in measurements obtained on the simulation range agree with the theory upon which the concept of a ground plane range is based. The effects of environmental variations on the performance of the Rat Scat range constituted one of the studies investigated using the scale range. Some results are presented in this paper. Author

N64-24806 Army Air Defense Engineering Agency, Fort Meade, Md. Field Operations Div.
FINAL SURVEY OF INFLATED AND RIGID RADOMES USEABLE WITH PRESENT DEPARTMENT OF ARMY AIR DEFENSE SYSTEMS RADARS
Mauno W. Laine Mar. 1964 81 p refs
(USAADEA-TR-14-1; AD-435743)

This report shows that the development and design of modern radomes have attained the stage where transmission losses, bore sight errors, and other negative factors are negligible. Difficulty in the manufacture of a uniform texture and in its application appears to be the greatest problem in the use of foam plastics in radome construction. Very little improvement in the structural mechanics or in the efficiency of electrical operation of radomes can be expected unless new materials with better mechanical and electrical characteristics and better techniques for their use are discovered. G.D.B.

N64-24808 Electromagnetic Technology Corp., Palo Alto, Calif.
FREQUENCY CONVERTER UNITS FOR L-BAND, S-BAND, C-BAND, AND X-BAND Interim Development Report, 1 Mar.–31 Mar. 1964
William A. Edson 15 Apr. 1964 17 p
(Contract NOBsr-89536)
(IDR-9; AD-435766)

The current program status includes the following: (1) Encouraging preliminary results were obtained with a coaxial impedance-matching network for the L-band version of the 3-db hybrid four-crystal converter using cutoff 1N53B crystals. The K-band match was also improved by the addition of a step transformer. (2) A double balanced modulator based on the TE_{11} mode in a coaxial line and using four outoff 1N53B diodes has been designed. (3) Three VX3352 crystals were tested. The crystals are somewhat variable and sensitive to burnout. (4) the noise figure of an experimental single crystal S-band up converter was measured as less than 13 db, at frequencies at which conversion loss was less than 10 db. (5) The automated apparatus for measuring the rectification characteristics of diodes was brought into operation. (6) Favorable preliminary results, both theoretical and experimental, have been obtained with the distributed-crystal holder approach. (7) Disappointing results with high-pass waveguide filters, using a circular cross section, have been traced to the undesired orthogonal mode. (8) Klystrons for the 40 frequency converters have been ordered. I.v.L

N64-24811 Lincoln Lab., Mass. Inst. of Tech., Lexington
INFORMATION CAPACITY AND QUANTUM EFFECTS IN PROPAGATION CIRCUITS
T. Hagfors 24 Jan. 1964 41 p refs
(Contract AF 19(628)-500)
(TR-344; ESD-TDR-64-23; AD-436639)

An attempt is made to establish an upper bound on the information capacity of an electromagnetic wave propagation circuit between two apertures when quantum effects come into play. The specifications of a signal are discussed, and it is found that BT quantities can be associated approximately with a signal of bandwidth B and duration T, and that the energy associated with these quantities must differ by at least hw. Radiative attenuation loss is considered within the framework of quantum theory, and it is found that the radiative attenuation introduces a random noise in the circuit that is analogous to partition tube noise. With the channel matrix determined, the problem of evaluating the channel capacity under average and peak power constraints is discussed. Author

N64-24813 Air Force Cambridge Research Labs., Bedford, Mass.
RESPONSE FUNCTION FOR TAYLOR ANTENNA DISTRIBUTIONS
C. J. Drane, Jr. and J. F. Mc Ilvenna, Jr. Sep. 1963 105 p refs
(ARCRL-63-368; AD-435621)

A simplified integral representation derived for the response function of the Taylor antenna distributions is of the form

$$\int_{|h|}^{s} I_0\left(s\sqrt{t^2 - h^2}\right) dt,$$

where $I_0(x)$ is the modified Bessel function of the zeroth order. An exact infinite series representation, together with an asymptotic representation for the integral, is presented. Tables and graphs related to the function, covering rather complete ranges of the parameter involved, are included. Author

N64-24853 Radio Corp. of America, Camden, N.J.
SYSTEMS ENGINEERING: II. COMMUNICATIONS SYSTEMS ENGINEERING
Richard Guenther *In its* Systems Eng. and Space Technol., [1964] p 4–9 refs (See N64-24851 17-01)

The complexities of communications systems engineering are described and discussed in terms of the basic tools and methods, systems tests, and business management. G.D.B.

N64-24855 Radio Corp. of America, Camden, N.J.
DESIGN OF A DATA COMMUNICATIONS COMPUTER SYSTEM
W. A. Levy and A. E. D. Mond *In its* Systems Eng. and Space Technol. [1964] 14–20 refs (See N64-24851 17-01)

The design of a data communications computer system is discussed in terms of the background of the application, the system functional capability, the equipment configuration, organization into processing cycles, organization of the traffic processing program, and the quantitative aspects of the program design. G.D.B.

N64-24857 Radio Corp. of America, Moorestown, N.J.
TOOLS AND TECHNIQUES FOR SPACE SURVEILLANCE STUDIES
J. Breckman, A. Franz, and S. G. Miller *In* RCA, Camden, N.J. Systems Eng. and Space Technol., [1964] p 35–39 refs (See N64-24851 17-01)

In conducting studies of space surveillance, a number of design and operational aids were developed, as well as procedures for applying these aids to space technology problems. These aids include B-charts, the PAGE computer program, and performance displays, each of which is discussed in this paper. G.D.B.

N64-24858 Radio Corp. of America, Princeton, N.J.
THE POTENTIALS OF HIGH-POWER SATELLITES FOR COMMUNICATIONS
A. C. Gay and J. S. Greenberg *In* RCA, Camden, N.J. Systems Eng. and Space Technol., [1964] p 40–49 refs (See N64-24851 17-01)

Major design considerations for a satellite communication system are the number of satellites and the orbital parameters. Most studies to date have been based on the simplest possible satellite configurations so as to enhance the life of the system and reduce the total cost of launch vehicles and satellites. In the near future, it will be necessary to evaluate the trade-off possibilities between low-powered satellites with large, costly ground terminals versus high-powered satellites with small, less costly ground terminals. High power in the satellite for two-way point-to-point communications is discussed. G.D.B.

N64-24859 Radio Corp. of America, Princeton, N.J.
OVERSEAS COMMERCIAL COMMUNICATIONS SATELLITE SYSTEMS: 1965–1975
J. S. Greenberg, S. Gubin, and M. Handelsman *In* RCA, Camden, N.J. Systems Eng. and Space Technol. [1964] p 44–48 refs (See N64-24851 17-01)

A study was made of commercial communication systems using active repeaters in earth satellites for planning purposes for RCA as an international common carrier and a supplier of electronic hardware. Discussed are traffic predictions, launch vehicles, satellite population, user rates, and other pertinent subjects. G.D.B.

N64-24862 Radio Corp. of America, Moorestown, N.J.
EVOLUTION OF THE HIGHEST-PRECISION RADAR: THE STORY OF MIPIR
John W. Bornholdt and William J. Rose *In* RCA, Camden, N.J. Systems Eng. and Space Technol. [1964] p 56–60 refs (See N64-24851 17-01)

Missile and space programs have presented requirements for highly accurate knowledge of the location, speed, and direction of travel of the vehicle. Pulsed radar has played a primary role in this measurement mission. This report describes highly accurate radars—the AN/FPQ-6, and its transportable companion, AN/TPQ-18, collectively known as MIPIR (Missile Precision Instrumentation Radar). G.D.B.

N64-24919* Ohio State U., Columbus, Ohio Antenna Lab.
PROPAGATION OF PLANE WAVES IN LOSSY MOVING MEDIA
J. R. Collier and C. T. Tai Repr. from IEEE Transactions on Antennas and Propagation, v. AP-12, no. 3, May 1964 1 p refs
(Grant NsG-448)

The propagation of plane waves in lossy moving media is determined by using Minkowski's theory of moving media. J.L.D.

N64-24950 Air Force Cambridge Research Labs., Bedford, Mass.
VISUAL DATA TRANSMISSION
Ronald J. Massa Apr. 1964 71 p refs *Its* Phys. Sci. Res. Papers No. 13
(AFCRL-64-323; AD-601053)

Statistical coding and visual fidelity criterion approaches to the television bandwidth reduction problem are described and contrasted. A review of techniques based on both approaches

is presented. A brief discussion of television signal properties and several television user applications is included. Emphasis is placed on bandwidth and/or power reduction through consideration and utilization of human visual summation properties. A class of reduced rate systems, with random-scanning, noninformation-bearing masks, and amplitude weighting is presented and discussed. Author

N64-24969 Hughes Aircraft Co., Culver City, Calif.
GENERALIZED COHERENCE THEORY
G. O. Young and A. Ksienski Mar. 1964 98 p refs
(Contract AF 19(628)-333)
(SR-3; AD-600480)

The coherence properties of electromagnetic waves bear a direct relationship to their information-carrying capacity. Thus, a maximum information transfer can only be accomplished by means of a coherent field. The coherence function is defined as a space-and-time averaged correlation function between field strengths at two points in a 4-dimensional space–time domain. The field is defined as coherent when the coherence function is a periodic function of an increment in the space–time coordinates. The field is defined as incoherent when the coherence function is zero. If the coherence function satisfies neither of these conditions, the field is partially coherent. A number of examples are worked out of the coherence properties of monochromatic and polychromatic waves emitted by either point sources or extended objects. The effect of aperture limitation on the coherence properties of the image of the above sources is also investigated. Author

N64-24984 Chance Vought Corp., Dallas, Tex. Astronautics Div.
RADAR RESOLUTION STUDIES
A. C. Morris 9 Jun. 1964 57 p
(Rept.-00.460)

This report presents the introductory mathematics for radar resolution studies and an analysis of a passive con-scan tracking system for two cases of detection, i.e., phase-lock and square-law detection. I.v.L.

N64-25001* National Aeronautics and Space Administration Space Flight Center, Greenbelt, Md.
ION SHEATH EFFECTS NEAR ANTENNAS RADIATING WITHIN THE IONOSPHERE
H. A. Whale (Auckland U., New Zealand) Repr. from J. of Geophys. Res., v. 69, no. 3, 1 Feb. 1964 p 447–455 Previously Published as NASA-TN-D-1746; see N63-16163 13-12)
(NASA-RP-211; NASA-TN-D-1746)

A theoretical treatment of the electron displacement in the vicinity of a linear cylindrical antenna immersed in the ionosphere was developed to explain the surprisingly thick ion sheaths that have been observed experimentally when large RF voltages are applied to the antenna. The force that displaces the electrons is obtained from numerical solutions to the nonlinear differential equation describing their motion, and the results are found to be consistent with the observations. Author

N64-25129 Radio Corp. of America, Camden, N.J. Communications Systems Div.
X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM. VOLUME 2: AIRBORNE EQUIPMENT Development Engineering Report
31 Mar. 1964 147 p
(Contract AF 33(657)-7134)
(CR-64-408-34.2-1; AD-437831)

The following are discussed: (1) SHF test-data/voice transmitter, (2) transmitter antenna multicoupler, (3) SHF command receiver, (4) SHF command decoder set, (5) C-band tracking equipment, (6) UHF voice receiver/transmitter, (7) UHF command receiving set, (8) control/intercom, and (9) UHF search and rescue receiver/transmitter. R.T.K.

N64-25180 Mitre Corp., Bedford, Mass.
METHOD FOR INCREASED DATA RATE IN TRANSMISSION OVER TIME-VARYING MULTIPLE PATHS
W. J. Albersheim Apr. 1964 45 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-79; AD-438431; TM-3591)

The bandwidth and data rate of communication over multiple paths, such as tropospheric scatter, are limited by time spread. If the characteristics of the transmission channel vary slowly, they can be probed by a pilot signal and corrected. The proposed method transmits evenly spaced pilot pulses that are separated from the messages by isolation gaps, and corrects the path distortion by analyzing the complex frequency characteristic of the received pilot pulses. An increase in data rate of from 10^5 to 3.10^6/sec appears feasible under some conditions. Author

N64-25208 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
TELEMETRY DIGITAL OUTPUT TERMINAL
Robert A. Offutt Mar. 1964 16 p refs
(ERDA-117; AD-440760)

This report describes the Telemetry Digital Output Terminal (DOT), which provides the necessary digitizing and formating of telemetered data for real-time data analysis. The DOT consists of a 16-channel data digitizer, storage and message assembling logic, and an output-format converter. The DOT accommodates up to 16 analog channels and up to 32 channels of 16-bit digital data at rates up to 100 per second per channel and will transmit data to the IBM 7281 input unit of the IBM 7094 computer at bit rates up to 50 kc. Author

N64-25229 Polytechnic Inst. of Brooklyn, Farmingdale, N.Y.
ELECTROMECHANICAL PULSERS
Griffiss AFB, N.Y. RADC, Apr. 1964 93 p refs
(Contract AF 30(602)-2149)
(PIBMRI-1138-63; RADC-TDR-63-436; AD-601614)

The feasibility of the generation of short-pulsed d.c. power by means of electromechanical energy conversion is investigated. A two-coil primitive system is analyzed, and the effect, on the output of a third short-circuited coil closely coupled to the excitation winding, is studied with respect to both the pulse magnitude and the pulse shape. From the results obtained, a shielding scheme is developed, and the basic electromechanical pulser is evolved, the main feature of the developed pulser being a conducting cylinder surrounding the armature. The conducting cylinder accomplishes the dual purpose of shielding the armature from the main pole iron, resulting in a drastically reduced armature self-inductance, and shields the excitation circuit from the effects of the armature reaction thus making the excitation circuit, in effect, current source driven. It is shown that by means of the shielding scheme outlined, the armature self-inductance can be reduced by nearly three orders-of-magnitude. As the power output of the electromechanical pulser is primarily limited by the armature self-inductance, this reduction amounts to a three-orders-of-magnitude increase in the power output. For a typical case it is shown that, for 1 msec pulses, with the maximum impressed field flux density of 1.5 $W/_{m^2}$ and the armature angular velocity of 200 m/sec, power outputs of the order of 100 mw per unit armature volume are possible. Author

N64-25233 Syracuse U. Research Inst., N.Y.
EFFECT OF SMALL DISCONTINUITIES ON THE INPUT VSWR OF A LONG TRANSMISSION LINE
Jose Perini Griffiss AFB, N.Y., RADC, May 1964 27 p refs
(Contract AF 30(602)-2646)
(RADC-TDR-64-121; AD-602111)

Many modern communication systems use long-transmission lines or waveguides to connect the transmitter to the radiating antenna. In many instances, rigid transmission lines or waveguides are used. They are usually made of sections approximately 6m long that are then joined together. Each joint represents a small discontinuity whose reflections, at certain frequencies, may add in phase at the input, producing unacceptable VSWR's. This report analyzes such a problem, and the results show that the input reflection coefficient behaves like an array of isotropic sources positioned at each discontinuity. The well-studied theory of linear arrays then permits the prediction of the input reflection coefficient as a function of frequency, showing, for example, that it can be as large as the sum of all the individual reflection coefficients, or as low as zero (perfect match). Experimental verification has excellent agreement with the theory. Author

N64-25234 Illinois U., Urbana Electrical Engineering Research Lab.
STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES Fourth Quarterly Report, 1 Dec. 1963–29 Feb. 1964
Griffiss AFB, N.Y., RADC, May 1964 15 p refs
(Contract AF 30(602)-3046)
(RADC-TDR-64-136; AD-601613)

This program has as its goal the development of video detection techniques that are appropriate for the millimeter and submillimeter range of the spectrum. Measurement of the sensitivity of the TGS pyroelectric effect detector indicates a minimum detectable signal level of approximately 4 microwatts. Additional studies on the theory of the reflecting beam waveguide indicate that at least two reflector shapes are permitted by the approximate theory developed for the analysis. If any differences in the electromagnetic fields corresponding to these two types of reflectors exist, they are obscured by the approximations made in the analysis. Author

N64-25240 Rome Air Development Center, Griffiss AFB, N.Y.
WIDEBAND, HIGH GAIN, VARIABLE TIME DELAY TECHNIQUES FOR ARRAY ANTENNAS
John B. Payne Jun. 1964 25 p refs
(RADC-TDR-64-218; AD-602248)

This report discusses two improved techniques for obtaining a wideband, high-gain, nondispersive, variable-time delay device to steer array antennas. The first time delay technique uses two wideband helix structures separated by a cylindrical drift tube to obtain a variable delay of 20 or more nanoseconds with a gain of 20 to 30 db. A variable delay is obtained by controlling the beam velocity through the drift region by varying the drift tube potential. Gain variation is minimized by maintaining constant beam velocity through the helices. The second method is a digital technique in which different time delay elements are switched into the signal path. In this technique, each switch is replaced by a wideband amplifier that determines the system bandwidth (200 to 800 mc). Author

N64-25325 Raytheon Co., Santa Barbara, Calif.
FEASIBILITY STUDY OF ANTENNA TECHNIQUES INCORPORATING UNIDIRECTIONAL DEVICES AS FUNCTIONAL ELEMENTS Interim Engineering Report, 1 Feb.–15 Jun. 1964
M. J. Bock and G. E. Malby Wright-Patterson AFB, Ohio, AF Avionics Lab., 15 Jun. 1964 70 p refs
(Contract AF 33(615)-1256)
(IER-1; AD-442072)

An analysis and experimental verification established the feasibility of integrating a nonlinear, unidirectional current device into a conductor to form a controlled unified radiating element. Author

N64-25334 Naval Research Lab., Washington, D.C. Radio Div.
AN APPLICATION OF BOSE-CHAUDHURI ERROR-CORRECTING CODES Interim Report
F. A. Polkinghorn, Jr. 25 Sep. 1963 14 p refs
(NRL-5993; AD-426311)

This report proposes a solution to the problem of the use of error-correcting codes on a particular multichannel HF radio circuit with a slowly time-varying probability of bit error, and states in detail a computer algorithm for this solution. The conclusion is reached that the single, double, and triple error-correcting Bose–Chaudhuri codes of block length 31, which have been stunted to a block length of 30, should be used. A small general purpose computer will be used to decode the blocks, possibly to compose a request for retransmission of uncorrectable errors, and to decide, on the basis of current error rates on a particular channel, the type of code to be used on that particular channel. Author

N64-25404 Republic Aviation Corp., Farmingdale, N.Y.
PRELIMINARY DESIGN STUDY OF A FLAT PLATE REFLECTOR AND SUPPORT UNIT Scientific Report No. 1
Stanislaus Dubowski Apr. 1964 182 p
(Contract AF 19(628)-2995)
(RAC-2135; AFCRL-64-286; AD-602126)

Parametric studies were conducted for every component going into the plate system of the multiplate antenna. Cost analyses were made on combinations of techniques, tolerances, materials, fabrication, assembly, and installation with respect to a choice of operating capabilities of the entire antenna system. The optimum system will consist of 2,100 hexagon shaped plates, actuated hydraulically. Each plate will have an area of 900 sq ft and will operate satisfactorily in wind velocities up to 25 mph. In the proposed Arizona location, wind velocities are below this level 99.5% of the time. Numerous design and cost analyses are presented in graphical format to permit rapid tradeoffs in selecting optimum systems. Author

N64-25452 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPLICATION OF A BINARY-DECIMAL CODE IN DIGITAL READING IN A CODE-PULSE TELEMETRY SYSTEM
N. I. Kalatozishvili and K. N. Slovinskiy 19 May 1964 7 p refs
Transl. into ENGLISH from Priborostr. (Moscow), no. 9, 1963 p 18–19
(FTD-TT-64-302/1+2; AD-601810)

This article proposes using a binary–decimal code for transmitting telemetry signals to eliminate reception conversions. In a code-pulse telemetry with a pickup in the form of a photoconverter for assuring discreteness, the rotating disk is perforated for the binary code. To avoid gross errors in remote transmission, a code is selected for a minimum of errors, such as Gray's code. In the described binary–decimal code, the numbers of each decimal category are expressed by a tetrad—a four-category binary code. G.D.B.

N64-25486 Spectrolab, Inc., North Hollywood, Calif.
RESEARCH ON THE DEVELOPMENT OF ULTRA NARROW BAND FILTERS FOR OPTICAL AND SPECTROPHOTOMETRIC USE Technical Documentary Report, 1 Jan. 1959–30 Dec. 1961
Leopold Cann, Samuel Holmes, Noel Bowman, and Richard Mizrahi Wright-Patterson AFB, Ohio, ASD, May 1964 141 p refs
(Contract AF 33(616)-6237)
(ASD-TDR-63-523; AD-601836)

Filters with bandwidths of approximately 0.5 A were desired for the visible region. A theoretical study was made into the various types of light filters with respect to their possibilities as narrow-band filters. Two approaches were considered for the development of very-narrow-band filters, and some prototypes have been successfully prepared. An investigation was made regarding the feasibility of producing narrow-band filters in the ultraviolet and infrared regions. A materials investigation was conducted for appropriate film components in these regions. Satisfactory films have been produced in the 3,000 to 4,000 A region. Author

N64-25614 IIT Research Inst., Chicago, Ill.
EVALUATION AND IMPROVEMENT OF RADAR BEACON SYSTEMS Seventh Quarterly Progress Report, 1 Dec. 1963–29 Feb. 1964
S. Kazel, G. Marazas, R. Standley, and P. Toulios [1964] 45 p refs
(Contract DA-36-039-SC-90693)
(QPR-7; AD-438876)

The effect of the coherent radar doppler tracking loop filter characteristic in reducing errors due to frequency instability in the radar transmitter are analyzed. Previous results in the literature, based on the use of doppler cycle counting alone, give too large a residual error at short ranges typical of earth-bound trajectories. The deficiency of doppler counting alone is found to be in its low skirt selectivity of 6 db/octave. A large reduction in velocity error at short ranges is obtained by going to a low-pass filter with 12-db/octave skirt selectivity. A previous analysis of the doppler errors due to beacon antenna rotation, based on a manual Fourier series analysis, has been refined by utilizing a digital computer to precisely calculate (1) the resultant phase of the 3-slot antenna, (2) the instantaneous rotational doppler shifts seen by the coherent radar, and (3) the effect of the low-pass characteristic of the doppler tracking loop in smoothing the input doppler errors. A summary is presented of work accomplished in the area of solid-state microwave design and evaluation for radar beacons. Author

N64-25651 Stanford U., Calif. Electronics Lab.
RADAR ACCURACY AND RESOLUTION IN A MULTIPLE-SIGNAL ENVIRONMENT Technical Report No. 2018-2
Bill B. May Jan. 1964 88 p refs
(Contract AF 33(657)-11144)
(SEL-63-151; AL-TDR-64-57; AD-437937)

The multiple-signal environment involves received data consisting of the sum of several signals and noise. Often the signals differ only in certain parameters such as amplitude and time of arrival. The measurement of these parameters is straightforward when the signals are separated in time; however, when the signals overlap in time, the receiving problem becomes difficult because the signals themselves act as interference in addition to the noise. Various receivers have been devised for the multiple-signal environment in this study. The optimum linear receiver, derived under an appropriate criterion, is shown to make possible a considerable improvement in data display as compared with that of the conventional matched filter. Only a small degradation in noise performance results; and the complexity, although greater than that of the matched filter, is well within reason. Author

N64-25676* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THE DEEP SPACE NETWORK
31 May 1964 141 p refs
(Contract NAS7-100)
(NASA-CR-56786; JPL-SPS-37-27, Vol. 3) OTS: $11.00 ph

The Deep Space Network (DSN) is a precision communication system designed to communicate with, and permit control of, spacecraft designed for deep space exploration. The following topics related to DSN are discussed: (1) tracking stations engineering and operations, (2) space flight operations facility, (3) DSN ground communication system, (4) communications engineering developments, (5) communications research and development, and (6) an advanced antenna system. R.T.K.

N64-25689* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PROPERTIES OF ERROR-CORRECTING CODES AT LOW SIGNAL-TO-NOISE RATIOS
Edward C. Posner 15 Jun. 1964 28 p refs
(Contract NAS7-100)
(NASA-CR-56789; JPL-TR-32-602) OTS: $2.60 ph

The use of error-correcting codes on a white gaussian channel is considered as the signal-to-noise ratio approaches zero. Two criteria of performance are used—the expected number of information bits in error and the probability of word error. If bit-by-bit detection is used, and if the expected number of bits in error is to be minimized, then maximum-likelihood decoding should be abandoned at low signal-to-noise ratios. In fact, coding should be abandoned altogether at low signal-to-noise ratios in favor of longer integration time per bit. If word error probability is to be minimized, then error-correcting codes using bit-by-bit detection hardly yield any gain, and usually result in a loss. However, orthogonal codes using correlation detection give a gain approaching 3.4 db as the length of the code increases without bound. Author

N64-25733* Tennessee U., Knoxville
OPTIMUM RECOVERY OF A CONTINUOUS SIGNAL FROM TWO DISCRETE CHANNELS
James C. Hung Repr. From J. of the Franklin Inst., V. 277, No. 5, May 1964 p 428–443 refs
(Grant NsG-351)

Continuous signal recovery from discreta data received in communication and control systems is investigated. Generally, when two sets of discrete data, obtained independently, are available for the recovery of a continuous signal, the two sets have different data rates. Better signal recovery is said to be achieved when both rather than only one of the two sets are used in an optimum way. A procedure for optimum recovery using the two sets of discrete input data is developed, and methods for evaluating the mean-square error are shown. An example is given to illustrate the method and the quality of the double-input system. IAA

N64-25746 Radio Corp. of America, Camden, N. J. Communications Systems Div.
X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM, VOLUME I. SYSTEM AND SUPPORT Development Engineering Report
31 Mar. 1964 153 p
(Contract AF 33(657)-7134)
(CR-64-408-34.1-1; AD-437171)

The X-20 (Dyna-Soar) was intended to explore the performance characteristics of controlled flights in the transhomosphere region. Flight plans were to boost the X-20 glider into orbit from Cape Kennedy, using a Titan III booster. After de-orbit and a controlled flight through the reentry region, landing of the glider would have been at Edwards AFB. This report discusses system engineering pertinent to operational requirements, data flow, and performance specifications; logistics support; and product assurance. It describes the equipment of the airborne, surface, and aerospace ground subsystems. The reliability models called for in the communications and tracking subsystems are presented. I.v.L.

N64-25747 Radio Corp. of America, Camden, N.J. Communications Systems Div.
X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM, VOLUME 3. SURFACE EQUIPMENT Development Engineering Report
31 Mar. 1964 351 p
(Contract AF 33(657)-7134)
(CR-64-408-34.3-1; AD-437771)

This report includes discussions of the design and performance of the (1) super-high-frequency command transmitter; (2) microwave coupling assembly; (3) waveguide dehydrator; (4) amplifier–frequency-converter assembly; (5) slant-range unit; (6) monitor receiver assembly; (7) tracking receiver; (8) receiver multicoupler; and (9) antenna and tracking electronics. Also, the beam power transformer, the cooler unit, and the design and performance of the A-FC thermoelectric cooler are evaluated. I.v.L.

N64-25748 Radio Corp. of America, Camden, N.J. Communications Systems Div.
X-20 (DYNA-SOAR) COMMUNICATIONS AND TRACKING SUBSYSTEM, VOLUME 4. AEROSPACE GROUND EQUIPMENT (AGE) Development Engineering Report
31 Mar. 1964 165 p
(Contract AF 33(657)-7134)
(CR-64-408-34.4-1; AD-437200)

The aerospace ground equipment of the Dyna-Soar communications and tracking subsystem is discussed in five categories: (1) ground checkout equipment; (2) maintenance ground equipment; (3) base and range aerospace ground equipment; (4) antenna test unit; and (5) range checkout equipment, launch control equipment, and mobile checkout test station configuration. G.D.B.

N64-25763* Stanford Research Inst., Menlo Park, Calif.
THE SCATTERING OF SHF RADIO WAVES BY HAIL AND WET SNOW Final Report
A. S. Dennis Jun. 1964 49 p refs
(Contract NASr-49(02))
(NASA-CR-56940) OTS: $4.60 ph

Forward-scatter cross sections in hail and wet snow, which theoretically should exceed their back-scatter cross sections were derived from recorded data. Described briefly are the organization of the Colorado project, the equipment used, and the results of preliminary analysis. Computed forward-scatter cross sections, which are averaged over several kilometers along the receiver beam, ranged up to $10^{-6.4}m^{-1}$ at 9.10 Gc and $10^{-8.1}m^{-1}$ at 4.86 Gc. Also described are the propagation path and the equipment used on the California project and detailed discussion of the results. The most noteworthy findings are that forward scatter by wet snow in the C-band region can exceed the back scatter by as much as 15 db, and that the forward scatter from the melting layer contains a cross-polarized component that occasionally approaches the back scatter in the original plane of polarization. However, hail may have been present in the scattering volume when the cross-polarized component reached its maximum level. The implications of these findings are discussed briefly, but a complete assessment of their importance must await climatological studies of the frequency of the various precipitation forms and the heights to which the precipitation particles extend. Author

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-24241 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
RANDOM VIBRATION STUDIES OF COUPLED STRUCTURES IN ELECTRONIC EQUIPMENTS Technical Documentary Report, 15 Nov. 1962–15 Jun. 1963
Denis U. Noiseux, Charles W. Dietrich, Ewald Eichler, and Richard H. Lyon Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1964 103 p refs
(Contract AF 33(657)-9118)
(ASD-TDR-63-205, v. II; AD-435467)

This report presents techniques of measurement of power flow from a shaker to a structure, a detail analysis of the case of edge connections, the results of mechanical simulation of an acoustic test applied to a model electronic package, and a discussion of acoustic and vibration tests performed on an Atlas guidance computer. Author

N64-24327 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ORION-EMG 2355 TRANSISTORIZED EXPANSION-MEASURING BRIDGE
19 May 1964 6 p Transl. into ENGLISH from Orion EMG 2355 Transistorisierte Dehnungs-Messbrucke, Ungar. Aussenhandels-Unternehmen für Erzeugnisse der Instrumentenind., Budapest p 123–126
(FTD-TT-64-545/1; AD-441870)

A new, lightweight, portable a.c. Wheatstone bridge for field measurement of expansion is described. Transitorization of the double bridge makes possible the advantages of low weight, low power, small volume, safety, and high sensitivity. D.E.W.

N64-24346 General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
ULTRA HIGH POWER TRANSMISSION LINE TECHNIQUES Third Quarterly Report
John P. Quine Griffiss AFB, N.Y., RADC, Mar. 1964 29 p refs
(Contract AF 30(602)-2990)
(RADC-TDR-64-113; AD-601568)

The purpose of this investigation is to develop systematic procedures for selecting optimum waveguide configurations and designing waveguide components that will operate at high levels of peak and average power in the frequency range 1 to 10 Gc. In particular, the feasibility will be investigated of designing compact components such as bends, couplers, power dividers, tapers, and mode absorbers in waveguides having cross-section dimensions in the range 1.5 to 2.5 free space wavelengths. The report presents a theoretical discussion of tapers and spurious mode absorbers for oversized waveguide. Author

N64-24349 General Electric Co., Syracuse, N.Y. Electronics Lab.
SEMICONDUCTOR LASER AMPLIFIER TECHNIQUES (SEMLAM)
Griffiss AFB, N.Y., RADC, May 1964 37 p refs
(Contract AF 30(602)-3111)
(RADC-TDR-64-148; AD-601612)

Preliminary tests were started on the overall amplifier system, which includes an oxygen gas laser as an oscillator and GaAs laser diodes as an amplifier with the associated optical components and cryogenic dewar. The emphasis is to construct pulsed and CW GaAs laser diodes with SiO antireflection coatings. Author

N64-24372 Autonetics, Anaheim, Calif.
RELIABILITY ANALYSIS OF ELECTRONIC CIRCUITS
H. S. Scheffler et al [1964] 405 p refs

To design reliability into a product, specifications for component parts should be standardized, reflecting part degradation and tolerances. Analysis of designs should be made to determine compliance with these specifications. This manual provides circuit design engineers with computer programs and circuit subroutine information for design analysis using a variety of techniques: Mandex, Monte Carlo, moment, parameter variation, and Vinil methods. D.S.G.

N64-24385 Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
PASSIVE AND TRANSFORMERLESS LC, RC, AND RL ONE-PORTS
Kurt H. Haase Oct. 1963 60 p ref
(AFCRL-63-506; AD-423616)

This report is concerned with the circuitry and the emittance functions of transformerless and canonical LC, RC, and RL one-ports implying 1, 2, 3, and 4 passive elements. It contains a complete compilation of all formulas necessary for circuit analysis, circuit synthesis, and circuit conversions between equivalent circuits. Author

N64-24390 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
COMPATIBLE TECHNIQUES FOR INTEGRATED CIRCUITS Eleventh Quarterly Report, 1 Nov. 1963–31 Jan. 1964
[1964] 59 p
(Contract AF 33(616)-8276)
(AD-600961)

Progress is reported in the following areas: (1) the 120-mc transreceivers—final design of each individual block; (2) the fabrication of research vehicle devices—special circuits being fabricated for the digital communication system; and (3) the system considerations for the DCS research vehicle. Author

N64-24396 Stanford U., Stanford Calif. Electron Devices Lab.
DESIGN FOR A HOLLOW-BEAM, DISC-LOADED COAXIAL-LINE, TRAVELING-WAVE AMPLIFIER
H. A. Hogg Dec. 1963 64 p ref
(Contract DA-36-039-AMC-00094(E))
(SEL-63-139; TR-0358-2; AD-438253)

A detailed engineering design for a 20% bandwidth, 1 mw peak power output traveling-wave amplifier is presented. A hollow electron beam operating at 100 kv and 60 amp is used in combination with a disc-loaded coaxial line circuit. Experimental data on the electron gun, the mode-suppressing attenuator and the RF circuit are presented along with preliminary data on the overall tube assembly and d.c. operation. No RF gain or power output data are available. A number of design problems were solved in detail and these solutions are presented. Author

N64-24448 Radio Corp. of America, Harrison, N. J.
A LOW-NOISE, MULTIPLE-FUNCTION, X-BAND TRAVELING-WAVE TUBE Interim Development Report No. 7, 1 Dec. 1963–31 Jan. 1964
G. Hodowanec and R. Mc Murrough
(Contract NObsr-87535)
(Rept.-87535-Q7; AD-437360)

This report describes the work done in a program to design and develop a low-noise, multiple-function, X-band traveling-wave tube. A change was made in the three objective specifications for the tube that have to do with gain of the linear output, flatness of the limited output, and video output. Included in this report is a summary of the status of the original program, and of the work done on the tube of revised design. Author

N64-24506 Joint Publications Research Service, Washington, D.C.
IZVESTIYA VUZOV: INSTRUMENT BUILDING, NO. 1, 1964
S. I. Zilitinkevich, ed. 7 May 1964 207 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedenii, Priborostr. (Leningrad), v. 7, no. 1, 1964 p 1–162
(JPRS-24515; OTS-64-31225) OTS: $3.50

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N64-24507 Joint Publications Research Service, Washington, D.C.

PARAMETRONS WITH FIVE STABLE STATES

Yu. N. Yefimov *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 1–10 refs (See N64-24506 17-09) OTS: $3.50

Inductive parametrons with five stable states are considered. Design relationships and also theoretical and experimental characteristics of these parametrons are presented. The physical significance of the interpretation of the operation of the pentastable parametron is considered. Author

N64-24508 Joint Publications Research Service, Washington, D.C.

AN INVESTIGATION OF THE STABILITY OF OPERATION OF TUNNEL DIODES IN PULSE CIRCUITS

A. S. Mkrtchyan *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 11–17 ref (See N64-24506 17-09) OTS: $3.50

This paper reports on an experimental study of the variation of the triggering threshold of pulse-amplitude discriminators using tunnel diodes under various operational conditions. Author

N64-24510 Joint Publications Research Service, Washington, D.C.

A PULSE-WIDTH VOLTAGE CONVERTER OF THE SELF-BALANCING TYPE

A. M. Melik-Shakhnazarov and M. B. Leytman *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 29–38 refs (See N64-24506 17-09) OTS: $3.50

This paper presents the results of a study of a pulse-duration voltage converter of the self-balancing type. The advantages of this type of converter in comparison with those based on the principle of the use of a sawtooth voltage in the conversion of low voltages are noted. Author

N64-24512 Joint Publications Research Service, Washington, D.C.

BALANCING AMPLIFIER FOR A RECORDER

A. V. Lashas, and A. I. Motuza *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 48–55 refs (See N64-24506 17-09) OTS: $3.50

A circuit is proposed for a compensating electronic amplifier that can be used to increase the speed of response and the sensitivity of a low-impedance, magnetoelectric direct-writing recorder. Some results are presented of a study of the compensating network and also of the dynamic response of the compensated recorder. Author

N64-24514 Joint Publications Research Service, Washington, D.C.

DETERMINATION OF THE STATIC ACCURACY OF CLOSED SYSTEMS WITH RANDOM PROPERTIES

S. A. Ponyrko *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 70–78 ref (See N64-24506 17-09) OTS: $3.50

This paper considers closed systems whose elements are described in a stochastic form. The concept is introduced, and expressions are found for the static characteristics of such systems. The resulting relations permit the evaluation of the static accuracy of the systems. Author

N64-24515 Joint Publications Research Service, Washington, D.C.

CALCULATION OF THE REDUCTION GEAR RATIO IN AN OPTIMAL-RESPONSE SERVO SYSTEM

F. F. Kotchenko *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 79–86 refs (See N64-24506 17-09) OTS: $3.50

This paper presents the solution of the problem of the calculation of the optimum reduction gear ratio in an optimal-response servo system of low power. The results of the calculation are the nomograms presented and the approximate relations that permit determination of the optimal gear ratio of the speed reducer. Author

N64-24516 Joint Publications Research Service, Washington, D.C.

ANALOG-DIGITAL ADDER FOR FREQUENCY-PULSED SIGNALS

R. G. Karpov *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 87–97 refs (See N64-24506 17-09) OTS: $3.50

This report considers the problems of the application of analog–digital devices of the frequency-pulsed type. These devices are of interest since they permit the direct usage of signals without intermediate transformation into direct current voltages, as is required by the analog computers. The mathematical operations that are most often found in the various controlling or sensing computing systems, and that can also be accomplished by the analog–digital devices are discussed. The most significant sources of errors in the operation of the analog–digital devices are included. R.T.K.

N64-24517 Joint Publications Research Service, Washington, D.C.

ON THE STRUCTURAL ACCURACY OF POTENTIOMETRIC COMPUTERS

I. B. Vaysman *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 98–108 refs (See N64-24506 17-09) OTS: $3.50

This paper considers the errors of the multiplier circuits and the summing circuits of potentiometric computers, which arise as a result of the nonideality of the circuit. Author

N64-24525 Joint Publications Research Service, Washington, D.C.

A DEVICE FOR THE MEASUREMENT OF THE PULSE CHARACTERISTICS OF SEMICONDUCTOR DIODES

S. A. Yeremin and M. I. Shchevelev *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 186–190 refs (See N64-24506 17-09) OTS: $3.50

For the successful application of semiconductor diodes in pulse devices it is necessary to know their fundamental pulse characteristics. However, at the present time there is no simple measuring equipment with which the pulse characteristics of the semiconductor diodes can be measured. This report presents a description of an instrument that together with a pulse generator and an oscillograph, permits the measurements of the pulse parameters of the semiconductor diodes under conditions of single current pulses and in the switching regimes. Author

N64-24526 Joint Publications Research Service, Washington, D.C.

A SIMPLE METHOD FOR THE DETERMINATION OF THE ACTUAL VALUES OF THE FREQUENCY AND THE DEGREE OF DAMPING OF OSCILLATORS OF AN ELECTROMECHANICAL OSCILLOGRAPH

B. I. Makarov and V. V. Kornilov *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 190–195 refs (See N64-24506 17-09) OTS: $3.50

This paper considers the question of the determination of the actual values of the natural frequency and the degree of damping of oscillators for an electromechanical oscillograph. A simple method is described for the determination of these parameters from the reaction of the oscillator to a step function. Results are presented from the determination of the natural frequency and the degree of damping of the type MOV-2 oscillators. Author

N64-24527 Joint Publications Research Service, Washington, D.C.

ENGINEERING ANALYSIS OF THE ELECTRICAL REGIME OF NEW OSCILLATOR VACUUM TUBES

I. A. Soldatov *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 195–201 refs (See N64-24506 17-09) OTS: $3.50

This note considers the engineering analysis of the operating regime of vacuum tube oscillators using vacuum tubes with fan-shaped static characteristics. An approximation of the dynamic characteristics of the tubes is more convenient in the case of the fan-shaped static characteristics. Author

N64-24528* National Aeronautics and Space Administration, Washington, D.C.

SPACE ELECTRICAL POWER

Walter C. Scott and Fred Schulman Repr. from Astronautics and Aerospace Engineering May 1963 p 48–53 refs (NASA-RP-210)

Current research programs and recent developments in electrical power systems for space missions are discussed. Solar-cell-battery systems have demonstrated a 1,500-w capability; kilowatt systems have been studied and found feasible. Solar-thermionic systems, which offer cost and weight advantages while eliminating the radiation damage problems of solar cells, have progressed from research devices to flight-weight converters. Since the energy conversion equipment of solar-mechanical systems is similar to that used in nuclear dynamic systems, they have profited from SNAP program research. The SNAP 8 development program is aimed at a reliable long-life nuclear–electric generating system capable of providing 35 kw. Nickel–cadmium and silver–cadmium batteries as well as fuel cells for space missions are also discussed. D.S.G.

N64-24536 Joint Publications Research Service, Washington, D.C.

IZVESTIYA VUZOV: INSTRUMENT BUILDING, NO. 4, 1964

14 May 1964 201 p refs Transl. into ENGLISH of Izv. Vysshikh Uchebn. Zavedenii, Proborostr. (Leningrad), v. VI, no. 4, 1964 p 3–175

(JPRS-24617; OTS-64-31266) OTS: $3.50

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13. INVESTIGATION OF NONLINEAR PROPERTIES OF GYROSCOPIC SYSTEMS BY THE METHOD OF HARMONIC LINEARIZATION S. A. Chernikov p 123–137 refs (See N64-24549 17-15)

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N64-24537 Joint Publications Research Service, Washington, D.C.

CONCERNING THE FREQUENCY ERRORS OF R-C OSCILLATORS

B. N. Bukhanets *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 1–10 refs (See N64-24536 17-09) OTS: $3.50

The linear theory of self-excitation is used as a basis for analyzing the effect of the amplifier's parameters on the self-excitation frequency of an RC oscillator. General equations for self-excitation are given for determining the frequency errors for various types of circuits for RC oscillators. Author

N64-24538 Joint Publications Research Service, Washington, D.C.

FREQUENCY CHARACTERISTICS IN OUTPUT CONDUCTIVITY OF JUNCTION TRANSISTORS

E. B. Gribov *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 11–19 refs (See N64-24536 17-09) OTS: $3.50

This article describes the frequency characteristics in the output conductivity of junction transistors used as controlled nonlinear resistances. Simple approximations suitable for practical calculations are given. Author

N64-24539 Joint Publications Research Service, Washington, D.C.

TRANSFORMER-TYPE OF PULSED FREQUENCY METER

M. B. Leytman *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 20–32 refs (See N64-24536 17-09) OTS: $3.50

This article describes a pulsed frequency meter that uses a core having a rectangular hysteresis loop and a semiconductor triode. Equations are derived for calculations that take into account the nonideal rectangularity of the core's hysteresis loop, and methods are given for designing the circuit. Author

N64-24541 Joint Publications Research Service, Washington, D.C.

DYNAMIC CHARACTERISTICS OF STEP-BY-STEP MOTORS DURING UNIT DISTURBANCE

Ye. M. Dondik *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 42–48 refs (See N64-24536 17-09) OTS: $3.50

This article is concerned with the special features of step-by-step motors operating with unit disturbance. It cites several relationships that are required for the design of automatic systems actuated by step-by-step motors. Author

N64-24542 Joint Publications Research Service, Washington, D.C.

THE USE OF SILICON DIODES IN CIRCUITS OF MULTIPLYING UNITS BUILT WITH QUADRATIC FUNCTIONAL CONVERTERS AND WITHOUT REFERENCE VOLTAGES

Yu. A. Tarasov *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 49–59 refs (See N64-24536 17-09) OTS: $3.50

This report describes a method of building quadratic functional converters with silicon diodes for analog multiplying units. It also describes the features connected with designing and building of square-law generators. The principal circuits for the multiplication of two voltages ranging from −100 to +100 and from −10 to +10 v are presented. A comparative evaluation of the data obtained by experimental investigation is given. Author

N64-24543 Joint Publications Research Service, Washington, D.C.

UNIVERSAL "VOLTAGE-NUMBER" CODE CONVERTER FOR D-C AND A-C CONTROL SYSTEMS

V. A. Smirnov, V. B. Smolov, V. S. Fomichev, and Ye. A. Chernyavskiy *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 60–69 refs (See N64-24536 17-09) OTS: $3.50

This article describes the operating principle and the circuit of a universal code converter, which assures the coding of d.c. and a.c. voltages having fixed and arbitrary frequency and phase. The coding method uses the principle of compensation and balancing the input voltage with a feedback voltage obtained as a result of decoding the code collected in the register. Author

N64-24544 Joint Publications Research Service, Washington, D.C.

HIGHLY-RELIABLE OPERATIONAL MAGNETIC MEMORY UNIT

Ye. P. Balashov, V. L. Genkin, and M. S. Sorokin *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 70–78 (See N64-24536 17-09) OTS: $3.50

This article describes a memory unit that uses diode-digit-types of access and ferrite cores having a rectangular hysteresis loop. The information in the unit is read and recorded by full currents, which have less rigid requirements for stability of switching currents and which make the memory units more reliable, as a whole. Author

N64-24554 Joint Publications Research Service, Washington, D.C.

HEAT CALCULATION METHOD FOR LOW-POWER TRANSFORMERS

V. N. Cherkasov *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 169–181 refs (See N64-24536 17-09) OTS: $3.50

This paper describes the order of calculating the heat balance of low-power transformers based on a previously developed method. It contains results of experimental testing of this method on an armored power transformer. This method can be recommended for transformers with an overall power of 1 to 2 kw. Author

N64-24555 Joint Publications Research Service, Washington, D.C.

SEMICONDUCTOR SAWTOOTH-VOLTAGE STANDBY OSCILLATOR WITH IMPROVED CHARACTERISTICS

V. V. Novikov and B. Ye. Roshal' *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 182–186 ref (See N64-24536 17-09) OTS: $3.50

A description is given of a circuit of a standby sawtooth voltage oscillator built of semiconductor equipment with a capacitive feedback between the collector and the base circuits. Its purpose is to improve the fill (space) factor of the output pulses by retaining a high linearity for the voltage of these pulses. For the control of the collector's load it offers a new version using a diode. Author

N64-24570 Joint Publications Research Service, Washington, D.C.
EVAPORATION OF GOLD FROM THE SURFACE OF GRIDS AND CROSSARMS AND ITS DISTRIBUTION ON ELEMENTS OF A RADIO TUBE WITH AN OXIDE CATHODE
A. D. Naroditskiy, L. M. Nikiforova, M. G. Khaliulin, and D. A. Khashbaktiyeva *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 35–38 refs (See N64-24564 17-23) OTS: $1.50

The control of thermoemission from grids in the production of radio tubes having an oxide cathode is studied. The industrial tube 6N6P was selected to investigate the evaporation of metals of antiemission covers of grids and the metals' distribution on the elements of the tube. In one experiment, the grid windings and crossarms were covered with gold, whereas in another experiment, only the crossarms were covered with gold. The grids of the tube were irradiated with neutrons in a reactor. It was shown that the thermoemission of the tubes may be eliminated by gilding the grids with gold; however, the same gold, when evaporated, can affect the emission of the oxide cathode. N.E.A.

N64-24571 Joint Publications Research Service, Washington, D.C.
PULSE HIGH-FREQUENCY ION SOURCE WITH SHOCK EXCITATION
G. A. Gumanskiy and V. V. Skvortsov *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 39–42 refs (See N64-24564 17-23) OTS: $1.50

This paper describes an ionic source working under pulse conditions in which a shock vibrational circuit is used for excitation of the damping high-frequency vibrations. The feed diagram with shock excitation of the vibrational circuit is simpler and more economical than a tube generator and, at the same time, allows the reliable synchronization of the operation of the ionic source with the help of an igniting electrode introduced in the spark discharger of the circuit. The results of the preliminary tests of the source are described. N.E.A.

N64-24572 Joint Publications Research Service, Washington, D.C.
VOLTAMPERE CHARACTERISTICS OF A RECTIFIER OF THE P^+-P-N^+ STRUCTURE IN A STRAIGHT LINE AT A HIGH LEVEL OF INJECTION
K. Mamatkulov *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 43–54 refs (See N64-24564 17-23) OTS: $1.50

A calculation is presented of the voltampere characteristics of a rectifier of the p^+-p-n^+-structure for three cases in relation to the voltage drop on the mass of the p^+, p, and n^+ regions. The finiteness of the rate of the recombination surfaces of electrons and holes on the ohmic contacts is considered. N.E.A.

N64-24596 Zenith Radio Corp., Chicago, Ill. Research Dept.
DEVELOPMENT OF A HIGH FREQUENCY ELECTRON-BEAM PARAMETRIC AMPLIFIER Final Report, 1 Jul. 1961–31 Jan. 1964
Peter G. Everett, Roy A. Larsen, and Charles G. Nelson
(Contract DA-36-039-SC-88915)
(Rept.-10; AD-439520)

Because of unanticipated sources of electron-beam noise at the beginning of this project, the original aim of a high-frequency nondegenerate amplifier was modified to the development of a d.c.-pumped amplifier with a high cathode magnetic field operating at L-band. This work demonstrated that in devices in which there is interaction between a slow-wave circuit and cyclotron waves, there is an upper limit of the beam radius–circuit wavelength factor of about 0.1. Since this condition implies high beam voltages for attainable circuit spacings, positive ions will always be a source of noise and a possible source of signal attenuation. The phenomenon of beam attenuation due to velocity spread has also proved to be a limitation on operation at high frequencies. D.S.G.

N64-24634 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FUNDAMENTALS OF RADAR
A. G. Saybel' 15 Feb. 1963 407 p refs Transl. into ENGLISH from the Book "Osnovy Radiolokatsii" Moscow, Izd. "Sovetskoye Radio", 1961 p 1–384
(FTD-TT-62-1215/1+2; AD-298779)

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3. RADIO RANGE FINDING p 72–170 refs (See N64-24637 17-09)
4. RADIO DIRECTION FINDING p 171–225 refs (See N64-24638 17-09)
5. DETECTION OF RADAR SIGNAL p 226–264 refs (See N64-24639 17-09)
6. FACTORS DETERMINING RADAR RANGE p 265–286 refs (See N64-24640 17-09)
7. FACTORS DETERMINING ACCURACY OF TARGET-POSITION DETERMINATION p 287–305 refs (See N64-24641 17-09)
8. MOVING TARGET INDICATION p 306–350a refs (See N64-24642 17-09)
9. RADAR-INFORMATION RELAYING p 351–370 refs (See N64-24643 17-09)
10. RADAR COUNTERMEASURES p 371–398 refs (See N64-24644 17-09)

N64-24635 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTRODUCTION
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 3–34 refs (See N64-24634 17-09)

Basic definitions are given for radar, targets, active and passive radar and their hybrids, and continuous and pulsed radiation techniques. The relationship of physical principles to target position determination methods is given. Scanning patterns are discussed, and a short history of radar and its applications, in the U.S.S.R., is given. D.E.W.

N64-24636 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
REFLECTING PROPERTIES OF RADAR TARGETS
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 35–71 refs (See N64-24634 17-09)

The effective scattering area of a target is introduced, and equations for scattered signal strength are given. Effective scattering areas of half-wave dipoles, flat surfaces, artificial targets, target groups, aircraft, and ships are discussed. Radio-wave reflection from ground and water surfaces, and the effective scattering area of three-dimensionally distributed targets are developed. D.E.W.

N64-24637 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADIO RANGE FINDING
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 72–170 refs (See N64-24634 17-09)

Methods of range finding with radio waves include the phase method, the frequency method, and the pulse method. Each method is described, and accuracy is discussed. Special aspects of frequency and pulse methods are discussed at considerable length. D.E.W.

N64-24638 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADIO DIRECTION FINDING
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 171–225 refs (See N64-24634 17-09)

Phase methods, amplitude-phase methods, and amplitude methods of direction finding are described. The accuracy of amplitude methods is evaluated, and formation of the equal-signal direction is discussed. Generating the equal-signal direction in the vertical plane, determining target height, and automatic direction tracking systems are described. D.E.W.

N64-24639 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETECTION OF RADAR SIGNALS
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 226–264 refs (See N64-24634 17-09)

In the ultrashort-wave range, the basic forms of natural noise include thermal, cosmic, internal receiver, and transmitter noise. Signal separation from noise is analyzed, and the interaction of noise and radar signals is treated at length. Statistical criteria for signal detection, the signal detection power threshold, and postdetection signal integration are covered. D.E.W.

N64-24640 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FACTORS DETERMINING RADAR RANGE
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 265–286 refs (See N64-24634 17-09)

Maximum radar range is determined from threshold power, P_{thr}, and is

$$R_{max} = \sqrt[4]{\frac{P_1 G_1 S_2 S_0}{(4\pi)^2 P_{thr}} \eta_1 \eta_2}$$

when P_1 = transmitter power, G_1 = transmitter-antenna gain constant, η_1 = transmitter feeder-line efficiency, S_2 = effective area of the receiving antenna, η_2 = receiver feeder-line efficiency, and S_0 = effective target scattering area. The atmosphere refracts radar signals closer to the earth and attenuates them in accordance with a long discussion given here. Earth effects on range, and usable detection zones are discussed. D.E.W.

N64-24641 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FACTORS DETERMINING ACCURACY OF TARGET-POSITION DETERMINATION
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 287–305 refs (See N64-24634 17-09)

Position-line error and position error are discussed. Error ellipses on a surface and error ellipsoids in three dimensions are introduced to describe areas of equally probable error. It is stated that three-dimensional position-determination accuracy may be characterized either by the error ellipsoid for a given probability or by the magnitude of the mean-square position error. D.E.W.

N64-24642 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MOVING TARGET INDICATION
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 306–350a refs (See N64-24636 17-09)

Extraction of the moving-target signals from the entire group of reflected signals arriving at the radar-station receiver input is accomplished by coherent and noncoherent methods. The former are based on use of the doppler effect, whereas the latter depend on the comparison of reflected signals separated by a specific time interval. Continuous-wave coherent methods and coherent pulse methods are discussed. Coherent voltage production is described, and compensation of stationary-target signals is treated for both a stationary radar and an airborne, moving installation. Factors in operating quality of such systems include parasitic modulation, fluctuation signals from stationary targets, signal modulation by beam movement, radar-unit frequency instability, and pulse-length variation D.E.W.

N64-24643 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADAR-INFORMATION RELAYING
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 351–370 refs (See N64-24634 17-09)

Modern radar-information relaying systems are classified into three groups: (1) television systems; (2) systems with continuous transmission of radar signals; and (3) systems transmitting converted radar signals. Television systems may use a television pickup tube or a tube that stores electrical charges (of the memory-tube type). Direct radar-signal transmission systems permit enlarged pictures of sections of the radar working zone, but have a broad signal bandwidth and require additional signals for the antenna azimuth. Converted radar-signal transmitting systems compress the signal spectrum and provide better reliability through reduced bandwidth. D.E.W.

N64-24644 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADAR COUNTERMEASURES
A. G. Saybel' *In its* Fundamentals of Radar 15 Feb. 1963 p 371–398 refs (See N64-24634 17-09)

Radar countermeasures may be divided into these three forms: (1) protective coatings; (2) passive electronic countermeasures (ECM); and (3) active ECM. Protective coatings are made from materials that absorb radio waves. Passive ECM includes interference created by artificial reflectors. Active ECM includes interference created by jammers. All forms can be combined in any way. Coatings operate by absorption or internal interference. Artificial reflectors include halfwave, corner and biconical reflectors, and Luneberg lenses. Active ECM takes the forms of continuous and pulsed jamming. Continuous jamming is either of the barrage or of the spot variety, and pulse jamming is divided into synchronous and asynchronous types. Efficiency and effectiveness are discussed for all types. Radar reconnaissance is treated at length, and electronic counter-countermeasures are briefly mentioned. D.E.W.

N64-24667 Westinghouse Electric Corp., Washington, D.C.
HIGH CURRENT AND HIGH VOLTAGE SILICON CONTROLLED RECTIFIERS Quarterly Report, 1 Jul.–30 Sep. 1963
[1963] 23 p ref
(Contract NObsr-87647)
(QR-5; AD-436351)

Results of recent device evaluation indicates that silicon aterial remains to be the major problem. Large-diameter crystals (1.25 inch) have yielded poor results; it is therefore necessary to return to the smaller diameter (1.25-inch) material. The problems of high voltage yield and dv/dt adjustment

are examined with respect to design and fabrication process. Results of devices fabricated on 1.250-inch crystal are reviewed. Electrical characteristics are reviewed and analyzed with respect to probable device application. Author

N64-24668 Royal Inst. of Tech., Stockholm (Sweden)
INTERACTION BETWEEN MICROWAVES AND PLASMAS IN GAS DISCHARGES AND SEMICONDUCTORS
B. Agdur 31 Jan. 1964 124 p refs
(Contract AF 61(052)-552)
(RADC-TDR-64-93; AD-431547)

CONTENTS:

1. EXCITATION OF PLASMA WAVEGUIDES WITH BACKWARD WAVE MODES B. Agdur and B. Enander p 1–22 refs (See N64-24669 17-24)
2. A DISCONTINUITY PROBLEM IN A CIRCULAR WAVEGUIDE CONTAINING TWO DIELECTRICS B. Enander p 23–41 refs (See N64-24670 17-08)
3. INVESTIGATION OF BACKWARD WAVE MODES IN PLASMA WAVEGUIDES L. Alfredsson p 42–62 refs (See N64-24671 17-08)
4. PLASMA RESONANCE IN A GERMANIUM ROD F. Sellberg p 63–83 refs (See N64-24672 17-25)
5. MAGNETO-PLASMA RESONANCE P. Hedvall and F. Lindvall p 84–93 refs (See N64-24673 17-25)
6. VARIATION OF PLASMA PARAMETERS ALONG A POSITIVE COLUMN OF A MERCURY DISCHARGE J. Bach-Andersen and A. Nord p 94–102 refs (See N64-24674 17-24)
7. EXPERIMENTS ON NOISE RADIATION FROM A PLASMA IN A WAVEGUIDE B. Kerzar p 103–112 (See N64-24675 17-24)
8. MICROWAVE EMISSION FROM A CYLINDRICAL PLASMA P. Weissglas p 113–121 (See N64-24676 17-24)

N64-24686 Joint Publications Research Service, Washington, D.C.
ON APPLICATION OF THE ABSTRACT THEORY OF AUTOMATONS FOR MINIMIZATION OF MICROPROGRAMS
V. M. Glushkov *In its* Tech. Cybernetics 1 May 1964 p 1–9 ref (See N64-24685 17-16) OTS: $5.00

The problem of the possibility of representation of microprograms for electronic computers in the form of automatons is investigated for the purpose of application of minimization methods of automatons to decrease the number of commands in a microprogram. A specific example of minimization is analyzed. Author

N64-24687 Joint Publications Research Service, Washington, D.C.
AN ALGORITHM FOR MINIMIZATION OF MICROPROGRAM SCHEMES
L. V. Matsevitiy *In its* Tech. Cybernetics 1 May 1964 p 10–25 refs (See N64-24685 17-16) OTS: $5.00

In circuits for conversion of discrete information, conversion takes place by application of a series of elementary operations to the initial information. This series is determined by the conversion algorithm. A method is discussed for finding equivalents for some algorithms and for selection of the algorithm with the least number of elementary operations. R.T.K.

N64-24696 Joint Publications Research Service, Washington, D.C.
SOME BASIC PROPERTIES OF MASS SERVICE SYSTEMS WITH CONSTANT PRODUCTIVITY AND BREAKDOWNS, "LOSSES"
I. P. Paderno and V. A. Usachev *In its* Tech. Cybernetics 1 May 1964 p 130–140 refs (See N64-24685 17-16) OTS: $5.00

A system is investigated in which the claims arriving are simultaneously serviced by all servicing apparatus. If the number of claims in the system is equal to the number of servicing apparatus, then newly arriving claims are refused ("lost"). Formulas are presented for the probabilities of finding in the system a number of claims under stabilizing and stationary conditions and for determination of the average load of the servicing apparatus. The basic properties of the system are described and are compared with the usual servicing system, the Erlang system. Author

N64-24703 Joint Publications Research Service, Washington, D.C.
SYNTHESIS OF A COMPLEX SYSTEM CONSISTING OF CONTINUOUS AND DISCRETE CHANNELS
I. B. Chelpanov *In its* Tech. Cybernetics 1 May 1964 p 232–248 refs (See N64-24685 17-16) OTS: $5.00

Procedures are developed for determination of pulse transfer functions of filters in complex two-channel systems with noise. The condition of minimum error dispersion is discussed for the case where information arrives continuously along one of the channels and at discrete points in time along the other channel. Author

N64-24784 Rome Air Development Center, Griffiss AFB, N.Y.
RADAR SITING BY TRILATERATION
Blase J. Chiarello May 1964 14 p refs
(RADC-TDR-64-131; AD-601567)

This report describes a trilateration technique that would be advantageous for the rapid positioning of mobile electronic equipment. Specifically positioned were two vertices of a test quadrilateral near Griffiss Air Force Base, Rome, New York. Slope distance measurements were made with the Electrotape DM-20. Azimuth control was obtained by use of Wild T-3 Theodolites. The results of positioning the two unknown points were compared to positions previously obtained by triangulation for the points. The minimum accuracy for the distance measurements was calculated at 1 part in 87,617. The maximum positional and azimuth errors were 7.5 in. and 3.75 sec, respectively. Author

N64-24809 Tung-Sol Electric, Inc., Bloomfield, N.J.
HIGH SPEED POWER AMPLIFIER USING ELECTRON BEAM SWITCHED P-N JUNCTIONS Interim Development Report, 27 Dec. 1963–26 Mar. 1964
14 Apr. 1964 13 p
(Contract NObsr-89493)
(AD-436595)

Electron beam multiplier (EBM) tubes have been further developed to give a 10-amp positive pulse at 300 v for a bare-junction silicon diode with heat sink. The beam current was in the order of 2 ma at 20 kv. The current gain was thus 5,000. This was confirmed also by d.c. measurements at low current. The grid pulse was 1μsec in duration at 100 pps. These improvements were achieved mainly by modifications in processing to greatly reduce contamination of the diode. Electron gun development has given a 4.0-ma beam current at zero bias and a cutoff of −40 v. Author

N64-24810 Michigan U., Ann Arbor Cooley Electronics Lab.
FORCED OSCILLATIONS IN A CLASS OF SELF-BIASED MULTIMODE OSCILLATORS

F. N. Bailey Mar. 1964 48 p refs
(Contract DA-36-039-SC-89227)
(TR-139; Rept.-4853-19-T; AD-436335)

The behavior of a class of multimode oscillators having two nonlinear elements and operating under the influence of an external signal is analyzed using the approximation procedures of Krylov, Bogoliubov, and Mitropolsky. Although the features of the basic circuit are chosen to conform to the general characteristics of common self-biased oscillators, the procedures employed are applicable to a large class of problems involving two nonlinear elements. Through the approximating procedure, the system of nonlinear differential equations describing the basic circuit is replaced by a new, more tractable system of three first-order nonlinear differential equations. Phase space solutions of this approximating system are then used to predict and analyze several interesting features of forced oscillator operation including frequency entrainment, pulling, and superregenerative detection. The results of the theoretical analysis are shown to be in very close agreement with the actual behavior of an experimental oscillator. Author

N64-24817* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THEORETICAL STUDY OF ZERO-FIELD ELECTRON WORK FUNCTION OF METAL IMMERSED IN GAS-DIRECT APPLICATION TO CESIUM THERMIONIC DIODE
Keung P. Luke and John R. Smith Washington, NASA, Jul. 1964 69 p refs
(NASA-TN D-2357) OTS: $1.75

It is well known that adsorbed gas on a metal surface can change significantly the electron work function of that metal. This phenomenon is of great importance in the field of gaseous thermionic energy conversion. In an effort to obtain an analytic relation that can predict quantitatively this phenomenon, the variation in the zero-field electron work function of a metal immersed in a gas is studied. This study begins with a general consideration of the dipole moment, the effective polarizability, the mutual interaction energy, and the desorption rate of a system of gas particles adsorbed on a metal surface. With the aid of several simplifying assumptions, two equations are then derived that relate the change in the zero-field electron work function of the metal to its surface temperature and the gas pressure and temperature. As an example, the change in the zero-field electron work function of tungsten immersed in a cesium vapor $\Delta\phi_e$ is computed and plotted against the ratio of the tungsten surface temperature to the cesium reservoir temperature at cesium reservoir temperatures T_{Cs} of 300°, 400°, 470°, 473°, 500°, and 600° K. The computed values of $\Delta\phi_e$ at T_{Cs} = 470°, 473°, and 500° K fit very well the experimental data of Houston and of Breitwieser on the cesium–tungsten system at the corresponding cesium reservoir temperatures. Author

N64-24825* Sperry Microwave Electronics Co., Clearwater, Fla.
PYROELECTRIC DETECTION TECHNIQUES AND MATERIALS
Washington, NASA, Jul. 1964 44 p refs Previously Published as NASA CR-44; see N64-18727 11-23
(Contract NASw-711)
(NASA-CR-44) OTS: $1.25

Measurements are reported on $BaTiO_3$ single crystals and ceramics, doped $BaTiO_3$, $PbTiO_3$, and a sample of triglycine sulfate. Measurements reported include noise equivalent power, responsivity, and response time on various detectors at optical and near infrared radiation frequencies. Measurements of detector characteristics as a function of temperature are reported. The results of analytical investigations of pyroelectric detectors are included. The detector equivalent circuit is derived and analyzed for sinusoidal and square wave modulation of radiation. Parameters of pyroelectric materials are related to detector characteristics. Author

N64-24837 Cornell U., Ithaca, N.Y.
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER GENERATION
Griffiss AFB, N.Y., RADC, May 1964 167 p refs
(Contract AF 30(602)-3243)
(RADC-TDR-64-140, v. III; AD-601153)

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1. REDUCTION OF SPURIOUS OUTPUT SIGNALS IN HIGH POWER KLYSTRONS A. R. Howland, Jr. p 1–57 refs (See N64-24838 17-09)

2. A STUDY OF SPACE-CHARGE WAVE PROPAGATION ALONG A PERIODICALLY VARYING ELECTRON BEAM M. Roberts p 59–149 refs (See N64-24839 17-09)

N64-24838 Cornell U., Ithaca, N.Y.
REDUCTION OF SPURIOUS OUTPUT SIGNALS IN HIGH-POWER KLYSTRONS
A. R. Howland, Jr. *In its* Investigation of Linear Beam and New Concepts of Microwave Power Generation May 1964 p 1–57 refs (See N64-24837 17-09)

The study included the following: (1) the definition of the particular electromagnetic compatibility problem, (2) a solution for the problem, and (3) the design and construction of a high-power, hot-test facility for measuring spurious output signals. The approach in developing the cavity design was to consider the higher-order modes present in the output cavity and place these mode resonances systematically at optimum frequencies. The test facility was constructed from a high-power radar transmitter, and the transmission line included a signal-sampling network capable of measuring up to the sixth harmonic of an S-band fundamental signal. Absolute power measurements were made on the second and third harmonics of the VA-87C klystron (S-band). Relative power measurements were made on the second, third, fourth, and fifth harmonics of the SAL-36 klystron (L-band). These measurements, along with other pertinent data, are compared. Author

N64-24839 Cornell U., Ithaca, N.Y.
A STUDY OF SPACE-CHARGE WAVE PROPAGATION ALONG A PERIODICALLY VARYING ELECTRON BEAM
M. Roberts *In its* Investigation of Linear Beam and New Concepts of Microwave Power Generation May 1964 p 59–149 refs (See N64-24837 17-09)

The problem of space-charge wave propagation along a scalloped Brillouin beam is investigated both by analysis and experiment. The major result of the analysis is the description of the RF currents and velocities in the beam by the solutions of Mathieu's equation. Both growth and decay are predicted with a maximum instability rate of 6.8 db per scallop. This instability includes a locking between the periods of the space-charge wave and the scallop on the beam. Experimental evidence of both amplification and attenuation as well as of the locking phenomenon is presented and shown to agree with the predicted values. Effects of various parameters are discussed, and experimental data showing the effects of cavity position and magnetic field are presented as the bulk of the experimental work. Author

N64-24846* Yardney Electric Corp., New York, N.Y.
RESEARCH AND DEVELOPMENT STUDY OF THE SILVER-CADMIUM COUPLE FOR SPACE APPLICATION
Third Quarterly Progress Report, 1 Jan. – 31 Mar. 1964

Allen Charkey and G. A. Dalin [1964] 36 p
(Contract NAS5-2452)
(NASA-CR-57008) OTS: $3.60 ph

The cells on both long and short orbit regimes (as 5-cell batteries), have completed a series of 10 deep cycles at RT, −15° C, and 50° C. The data show the negative electrode is limiting at lower temperatures. A few of the cells on the short orbit have become negative limiting on charge and are evolving hydrogen. Because the cells are different in design and vary in capacity, the lower capacity cells tend to overcharge on each cycle and eventually produce hydrogen. To minimize this cell "unbalance," a special voltage scanning device is being constructed. Special instrumentation, which includes a rotating disc electrode apparatus for the investigation of the mechanism of gas recombination, has been constructed. Measurements of recombination rates in our sealed silver–cadmium cells produced for the first time a direct correlation between quantity of electrolyte and rate of recombination. Also, soluble organic products from the separator decrease the oxygen recombination rate. Author

N64-24848 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
DEVELOPMENT OF A LOW-NOISE, BACKWARD-WAVE OSCILLATOR
David Hallock Jan. 1964 37 p refs
(USAELRDL-TR-2441; AD-601246)

The program objective was to develop an oscillator that would be voltage tunable over the arbitrary range 2000 to 4000 mc with a signal-to-noise ratio of 120 db, measured 30 mc from the signal frequency. The design of the slow-wave structure is reviewed, and data obtained on the operating tube is presented. Past operation of the tube is discussed. Power output versus frequency data indicates that the tube will operate best in the range of 3.5 to 5.5 Gc. A value of 110 db for the signal-to-noise ratio was measured, indicating that the signal-to-noise objectives of the program will be met. Author

N64-24860 Radio Corp. of America, Burlington, Mass.
A HIGH-RESOLUTION RANGE COUNTER
L. C. Drew *In* RCA, Camden, N.J. Systems Eng. and Space Technol. [1964] p 49–51 ref (See N64-24851 17-01)

A feasibility model of a range counter that can operate at ±1-m resolution (150 mc) was developed. This paper describes some of the advanced circuit, logic, and mechanical design of the device, which utilizes digital microcircuits. Author

N64-24867 Bliley Electric Co., Erie, Pa.
RUGGEDIZED PRECISION CRYSTAL UNIT FOR AIRBORNE AND MISSILEBORNE FREQUENCY SOURCES Final Report, Mar. 1961–Nov. 1962
J. M. Wolfskill, R. T. Schlaudecker, J. E. Lawson, and R. C. Mouck Wright-Patterson AFB, Ohio, ASD, May 1963 45 p refs
(Contract AF 33(616)-8100)
(ASD-TDR-62-1054; AD-408775)

Investigation was made of the feasibility of requirements that had been set up to guide development of rugged, high-precision crystals for use in aircraft and missiles. It was not possible to meet all of these goals, but improved performances were obtained in shock, vibration, and orientation tests. A brief history of this study, review of evaluation problems, and design information on feasibility-model units are presented. Author

N64-24869 Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronic Systems
RADAR INTERFERENCE STUDY Scientific Report
Walter B. Mills and J. F. Clark Bedford, Mass., Electron. Systems Div., Apr. 1964 85 p refs
(Contract AF 19(604)-8484)
(ESD-TDR-64-240; AD-439263)

The electrical signatures of a particular type of radar interference, called angels, were studied. The types studied were single angel, group angel, and miscellaneous. Based on the electrical signatures obtained during the early part of the program, circuits were developed and implemented to eliminate the single and group types from the FPS-8 (L-Band) MTI radar outputs. Cancellation experiments as well as the circuits used are discussed in detail. A physical model is presented to account for the single angel returns. Among other properties, the model accounts for the angel beamwidth relative to "normal" targets and the Doppler-shifted angel spectrum unaccompanied by any visible translation. Author

N64-24871 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
ELECTRONIC EQUIPMENT INTERFERENCE CHARACTERISTICS—COMMUNICATION TYPE Quarterly Report No. 4, 15 Nov. 1963–15 Feb. 1964
O. H. Ogburn, E. E. Donaldson, Jr., P. T. Spence, and C. W. Stuckey 1964 52 p refs
(Contract DA-36-039-AMC-02294(E))
(Rept.-25; AD-439503)

Suggested testing techniques derived from standard spectrum signature tests conducted on U.S. Army microwave communications receivers are outlined. The importance of the receiver preselector in the receiver evaluation studies is emphasized. A finite mathematical model of a mixer characteristic is developed through the use of the Fourier series. Calculated harmonic levels based on the mathematical model were found to approximate the corresponding measured levels from a simple diode mixer circuit. Mixer theory is discussed for a vacuum tube triode mixer. Data taken on a 6J4 triode mixer are compared to responses computed by a previously developed prediction technique applicable for diode mixers. Author

N64-24895 General Motors Corp., Indianapolis, Ind. Allison Div.
ENERGY DEPOT ELECTROLYSIS SYSTEMS STUDY Final Report
J. E. Funk and R. M. Reinstrom 30 Jun. 1964 83 p refs
(Contract AT(30-1)-3101)
(EDR-3714, Vol. II, Suppl. A)

The results presented show that the ideal efficiency of a constant temperature and pressure chemical process that produces hydrogen from water is exactly the same as the ideal efficiency of an electrolysis process operated at the same temperature and pressure. It is further shown that there are inefficiencies in a chemical process that cannot be avoided. The fact is established that the reactions in a chemical process cannot be run at a single temperature if the process is to be more efficient than electrolysis. Specifications for compounds, which would yield efficient two-reaction chemical processes, have been developed. They appear in the form of free energy of formation and absolute entropy difference between the hydride or oxide of the compound and the compound itself. The absolute entropy change that occurs when either an oxygen atom or two atoms of hydrogen are added to a molecule can be determined semiempirically. These semiempirical correlations indicate that only certain gaseous compounds can meet the entropy specification. Author

N64-24914 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
RECORDING HANDBOOK
James A. Howard and Lester N. Ferguson 25 Mar. 1964 94 p refs
(Contract DA-36-039-AMC-00088(E))
(EDL-G169; AD-441137)

The purpose of this manual is to supply necessary information for the reliable operation of tape recorders. The theory of magnetic recording is presented, together with a description and operational characteristics of component elements of the device. Multiplex techniques, pulse recording, and dubbing are included. D.S.G.

N64-24931 Washington U., St. Louis, Mo.
RESEARCH IN FUNDAMENTAL PROCESSES OF ELECTRON EMISSION Final Report, 1 May 1961–31 Mar. 1964
Robert N. Varney 30 Apr. 1964 6 p
(Contract AF 19(604)-8435)
(AFCRL-64-405; AD-601384)

A target surface consisting of a metal base with a layer of either xenon or carbon dioxide frozen onto it has been examined for its efficiency as a secondary electron emitter. The surface did not give spontaneous emission as in the Malter effect. The surface did, however, appear to acquire a strong positive surface charge, indicating that secondary electron emission exceeded the incident primary electron current. Author

N64-24942 Hercules Powder Co., Wilmington, Del.
A STUDY OF THE ELECTRONIC CONFIGURATION AND BEHAVIOR OF THE -NF_2 GROUP Fifth Quarterly Report, Mar.–May 1964
A. D. Craig 25 Jun. 1964 45 p refs
(Contract DA-31-124-ARO(D)-62; ARPA Order-402)
(HRC-64-3; AD-441835)

The polarographic reduction of HNF_2 in nonaqueous aprotic systems is being studied to delineate the electrochemistry of N-F compounds. The results indicate that the mechanism in systems of limited proton availability consists of a series of steps that include protonation as well as electron-transfer steps. Macroscale controlled potential electrolysis has confirmed that HNF_2 is reduced at a mercury cathode in aqueous solution to ammonia in a four-electron reduction. The infrared spectrum of gaseous methyldifluoramine, CH_3NF_2, has been investigated over the range 250 to 4,000 cm^{-1}. The Henry's Law constants for NF_3 and N_2F_4 in water, methanol, ethanol, and acetonitrile have been determined. Preliminary results from electric-discharge experiments with NF_3 have yielded an N-F containing solid. The preparation of a metal-NF_2 compound, $(C_6H_5)_3SnNF_2$, is described. M.P.G.

N64-24944 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
TRANSISTOR CHARACTERIZATION AND DERATING FOR SECOND BREAKDOWN
Bernard Reich and Edward B. Hakim Jan. 1964 19 p refs
(USAELRDL-TR-2403; AD-600142)

Two modes attributing to secondary breakdown in transistors have been found—the current and the voltage modes. Localized spots due to current constriction as a result of either mode cause an exponential rise in thermal resistance prior to secondary breakdown. These localized secondary breakdown spots have been calculated to be between 900° to 1,100° C in silicon. The study indicates that the maximum secondary breakdown power is a function of the device design and should be considered in the light of other device performance requirements. Author

N64-24979 Astron Corp., East Newark, N. J.
PRODUCTION ENGINEERING MEASURE FOR CAPACITOR, VAPORIZED TEFLON, METALLIZED GLOW-DISCHARGED DEPOSITED DIELECTRIC FILM Fifth Quarterly Report, Jan. 1–Mar. 31, 1964
Stanley Berinstein [1964] 21 p
(Contract DA-36-039-AMC-01459(E))
(QR-5; AD-437185)

Capacitors of all three ratings were wound. Glofilm material has now been improved to the point where it is possible to wind good capacitor sections with a reasonable yield. It was also found that metal spraying the end connections according to the present state-of-the-art causes a degradation of the insulation resistance. Work was done on other methods of making end connections. Author

N64-24986 Oklahoma State U. Research Foundation, Stillwater
A TRANSISTORIZED DIGITAL COMPUTER WITH BOTH REAL AND STORED TIME ANALOG READOUT OF INFORMATION—FOR USE IN DEEP SPACE INVESTIGATIONS OF MICROMETEOR PHENOMENA Final Report, 1 May 1959–30 Apr. 1960
Dave C. Mueller (M.S. Thesis) Dec. 1963 96 p refs
(Contract AF 19(604)-5715)
(AFCRL-64-98; AD-435692)

This thesis describes the evolution of an electronic computer that will be used in conjunction with a series of micrometeor studies. It systematically presents sequentially the procedures followed in the conception, design and development, and production of the subject system. In several cases techniques presented in the literature were supplemented to solve circuit and system design problems imposed by environmental and flight vehicle specifications. Author

N64-25035 General Electric Co., Syracuse, N.Y. Heavy Military Electronics Dept.
SOLID STATE MICROELECTRONIC SYSTEMS Third Quarterly Progress Report, 1 Mar.–1 Jun. 1963
G. Danielson, R. Marolf, and R. Warr [1963] 83 p
(Contract DA-36-039-AMC-00020)
(Rept.-3; AD-437629) OTS: $8.10 ph

The possibility of replacing the existing telegraph terminal TH-22 (XC-3)/TG by a microelectronic design has been investigated. It is shown that, by a redesign of the terminal, standard digital integrated circuits can replace most of the conventional circuits presently used. A considerable reduction in volume, weight, and power consumption can be achieved. The realization of a bandpass filter similar to that of the F-316/U by means of active RC filters in a digital filter configuration has been studied. Two filters are being constructed to provide 3 db of ripple over a 200 cps bandwidth. Studies of throwaway and replacement concepts for microelectronics were initiated. Author

N64-25037 Texas Instruments, Inc., Dallas
TECHNIQUES FOR EXPERIMENTAL FABRICATION OF A 1-WATT, 1-GC GALLIUM ARSENIDE TRANSISTOR Fifth Quarterly Progress Report, 1 Aug.–31 Oct. 1963
Melvin Belasco, E. C. Wurst, and R. C. Sangster [1963] 41 p refs
(Contract AF 33(657)-8757)
(TI-08-63-157; AD-437653)

Gallium arsenide transistors with zinc-diffused base structures were built on both melt-grown and n-on-n epitaxial gallium arsenide. The common emitter current gain cutoff frequency of the transistors was between 300 and 700 mc. The d.c. current gain was typically 7, with many ranging up to 20

and 30. Gallium arsenide transistors were also fabricated from p-on-n epitaxial material. These devices featured uniformly high values of h_{FE}, typically 25. The f_t's were on the order of 80 mc. Transistors were also made using an evaporated emitter stripe geometry on Zn-diffused GaAs. The high-temperature (200° C) characteristics of a number of Zn transistors were studied. Radiotracer studies on zinc diffusion show that the shallow junction depths and low surface concentrations needed for an evaporated stripe structure are obtainable with diffusions from SiO_2 films. Junction capacitance vs applied voltage studies have been made on Zn-diffused diodes to double-check the impurity profiles. Similar measurements were also made on Te diodes. Author

N64-25047 Hughes Aircraft Co., Los Angeles, Calif. Space Systems Div.
SYNCOM 2 ELECTRICAL POWER SYSTEM
P. S. Du Pont N.Y., AIAA [1964] 8 p Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964 (AIAA Paper-64-456) AIAA: $0.50 members, $1.00 nonmembers

The electrical power system for SYNCOM 2 is performing perfectly, having already logged over 11,000 commands and over 2,000 hours of communications time. Experiments have included voice, facsimile, and television transmission. Discussion includes power system design criteria, air-mass one to air-mass zero extrapolation, and actual and predicted spacial performance. Analysis of the equivalent radiation environment is shown. The electrical power system differences between SYNCOMS 1 and 2 and SYNCOM C (scheduled for launch during the third quarter of 1964) are outlined. Author

N64-25079 Watkins-Johnson Co., Palo Alto, Calif.
DEVELOPMENT OF A MILLIMETER LOW-NOISE TRAVELING-WAVE AMPLIFIER Final Report, 1 Dec. 1960–31 Dec. 1963
E. W. Kinaman [1963] 115 p refs
(Contract DA-36-039-SC-87384; ARPA Order 141-60)
(Rept.-8; AD-440424)

Techniques were developed and applied, culminating in several practical wideband amplifiers. The highest overall gain noted was 45 db at band center (93.75 Gc), with best noise figure at 16 db. Operation from 68 to over 100 Gc was demonstrated, but the practical instantaneous bandwidth was limited to 15 or 20 Gc in each case, due to dispersion. Author

N64-25083 Republic Aviation Corp., Farmingdale, N.Y. Manufacturing Research Dept.
ELECTRO-SPARK EXTRUDING Interim Progress Report, 1 Jan. – 1 Apr. 1964
J. H. Wagner Wright-Patterson AFB, Ohio, Aeron. Systems Div., Apr. 1964 44 p refs
(Contract AF 33(657)-11265)
(RAC-2288; ASD-TR-8-111 (III); AD-435688)

The spark gap discharge phenomena as applied to experimental extrusion are reviewed. The equations derived for a thick-walled cylinder under transient internal loading are applied to check the stress levels encountered in two proposed experimental extrusion devices. The strength requirements of the equipment are reviewed and analyzed with both static and dynamic loading. A container concept is presented. Author

N64-25091 Bell Helicopter Co., Fort Worth, Tex.
ROTOR BLADE RADAR ANTENNA Phase I
Leonard R. Lindenmeyer and David W. Young (David W. Young and Associates, Inc.) 13 Jan. 1964 82 p refs
(Contract Nonr-4148(00))
(TR-299-099-251; AD-428242)

A research program to investigate the feasibility of using the main rotor blade of a helicopter as a radar antenna was conducted. Special blade sections were built and tested to study various design ideas. Digital computer studies of slotted arrays were programed on an IBM 7090 computer. Both a 43-in section and a 173-in section of UH-1B rotor blade were built with a slotted array placed near the trailing edge. These blade antennas were statically tested. Radiation pattern measurements were made of beamwidths, sidelobe levels, and front-to-back ratios. The problem of transmitting energy to a spinning rotor blade was examined, and preliminary sketches of the hub layout were made. A 0.28° beamwidth was obtained for the 173-in blade with the antenna focused at infinity. Sidelobe levels and front-to-back ratio were 20 db. Author

N64-25100 SFD Labs., Inc., Union, N.J.
DEVELOPMENT OF AN X-BAND CW CROSSED-FIELD AMPLIFIER Third Interim Development Report, 31 Dec. 1963 – 31 Mar. 1964
M. Arnum Apr. 1964 101 p refs
(Contract NOBsr-89503)
(SFD-33-IDR-3; AD-437818)

Slow-wave structures, namely, the choke-supported and the plain reactively loaded interdigital lines, capable of meeting the objective specifications of the program, have been evaluated at cold test. The choke-supported interdigital line structure, evaluated earlier, was abandoned. Emphasis has been placed on obtaining comparative electronic interaction impedance values for the two circuits and on obtaining an acceptable circuit impedance match across the desired frequency band. Two circuit impedance marching schemes were investigated. The plain reactively loaded interdigital line structure shows an apparent coupling impedance two to three times that of the choke-supported version. Construction of tubes incorporating these slow-wave structures for hot-test evaluation is in progress. Author

N64-25101 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
DEVELOPMENT OF A TRANSISTOR DELIVERING AN OSCILLATOR OUTPUT OF 250 MILLIWATTS AT 1.5 GIGACYCLES Quarterly Progress Report No. 3, Dec. 19, 1963-Mar. 19, 1964
Harry Cooke 17 Apr. 1964 33 p
(Contract NOBsr-89423)
(Rept.-03-64-23; AD-436710)

The 0.25w 1.5 Gc transistor program was converted from a germanium to a silicon transistor. Conversion was requested because the state of development of the silicon transistor was closer to the contractual requirements than that of the germanium transistor. The silicon transistor program is described in detail to include construction, oscillator parameters and characteristics, small-signal amplification, contact experiments, and 1.5 Gc experiments. Author

N64-25128 TRW Semiconductors Inc., Lawndale, Calif.
TRANSISTOR, VHF, SILICON, POWER (10W–500MC) Quarterly Report No. 2, 1 Oct.–31 Dec. 1963
J. Crishal and R. Neville [1963] 44 p
(Contract DA-36-039-AMC-03189(E))
(PSI-59-RD-2; AD-439230)

A phosphorus oxychloride source is used for n-type impurity diffusions, and an n-propyl borate, etch solution was worked out for p-type impurity diffusions. Gold and silver are being evaluated for over-the-oxide metalizing by evaporation. Difficulties in etching the metal between base and emitter stripes were encountered, due to the narrow spacing. A

modified disc power package will be used in the fabrication of this device. Initial tests at 250 mc indicate good performance. Typical d.c. tests at this time indicate collector-emitter breakdown voltages of 60 to 70 v at 100μa. Leakage currents are less than 1μa at 25 v collector–emitter voltage. Performance at 250 mc shows gains of 7 db at a 4.5-w level and 4 to 5 db at 7w (50% efficiency). Current levels sustained were high. Author

N64-25181 Naval Research Lab., Washington, D.C. Nucleonics Div.
A 550-MEGAWAT PULSE MODULATOR
J. P. Kitchen, D. C de Packh, H. R. D. Roess, and T. J. O'Connell 10 Apr. 1964 11 p
(NRL-6073; AD-439218) OTS: $0.50

The development of a 1,000-amp electron gun made a modulator necessary to supply pulse power to the gun. The stringent requirements imposed on the pulse characteristics by the gun preclude a run-of-the-mill type of modulator. These requirements are peak voltage in excess of 500 kv, flat top less than 1μsec in length with a flatness of 1% for at least 150 ns, and a rise and fall time less than 1μsec. A modulator has been developed and tested that meets or exceeds these requirements. A 0.5μf capacitor and a 0.3μf capacitor, each built up of silvered Mylar sheets, are contained in a hermetically sealed tank, and form part of a two-section network. The housing of a triggered spark gap acts as a low-impedance transmission line to connect across to another hermetically sealed tank containing a transformer and having on it a flange for attachment of the gun. The transformer has a single-turn primary and a 31-turn secondary. The leakage inductance of the transformer and its leads, which has to be small, is 0.12μh. To match properly with this, the inductance of the 0.5μf capacitor plus its connection to the 0.3μf capacitor is held below 0.06 μh. The Pulse repetition rate is one per second. Author

N64-25190 Hanford Atomic Products Operation, Richland, Washington Physics and Instruments Lab.
THE MEASUREMENT OF ULTRASONIC TRANSDUCER CHARACTERISTICS
M. F. Zeutschel Jun. 1964 35 p refs
(Contract AT(45-1)-1350)
(HW-81955) OTS: $1.00

Specialized broadband transmitting and receiving equipment was developed for performing transducer measurements. Special attention was given to the bandwidth and impedance levels in this equipment to insure that the information obtained is strictly determined by the transducer measured, without adding distortion from the ultrasonic instrumentation. G.D.B.

N64-25236 General Electric Co., Syracuse, N.Y. Heavy Military Electronics Dept.
DUPLEXER CU-551 ( )/U DEVELOPMENT OF HIGH POWER MULTIPACTOR DUPLEXERS AND SWITCHES Final Report
Griffiss AFB, N.Y., RADC, Jun. 1964 249 p refs
(Contract AF 30(602)-1641)
(RADC-TDR-64-165; AD-602167)

This report summarizes the design criteria and high and low level power testing data for an S-band duplexer, L-band duplexer, and an S-band switch. Developmental duplexers and switches are presented with a discussion of their advantages, their limitations, and their potential for future development. An extensive appendix is included, which deals with the space charge theory of the multipactor discharge and with the various aspects of the study of the multipactor phenomena. Author

N64-25237 Stanford U., Calif. Microwave Lab.
ON THE ANALYSIS AND SUPPRESSION OF OSCILLATIONS IN HIGH-POWER TRAVELING-WAVE TUBES
Griffiss AFB, N.Y., RADC, Jun. 1964 190 p refs
(Contract AF 30(602)-2575)
(RADC-TDR-64-172; AD-602286)

There are many factors involved in the design of a traveling-wave tube (TWT), the most important of which are gain, bandwidth, efficiency, and stability. The primary purpose of this study was to examine the question of stability in high-power TWT's that used coupled-cavity structures, both as to the concepts and theoretical description of the possible types of instabilities that can occur, and as to the possible schemes for making the tube stable. Of the three types of oscillations that are possible in a pulsed, high-power TWT, the band-edge oscillations were of primary interest. G.D.B.

N64-25239 General Dynamics/Electronics, Rochester, N.Y.
ADAPTIVE PROGRAMMING TECHNIQUES FOR CIRCUIT DESIGN
Griffiss AFB, N.Y., RADC, Jun. 1964 105 p refs
(Contract AF 30(602)-2961)
(RADC-TDR-64-194; AD-602110)

This is a report on efforts to develop pattern recognition techniques in general, and in particular, the application of threshold logic devices to pattern recognition. The threshold logic equation was generalized to handle pattern observables that are continuous variables. Emphasis was placed on the classification with minimum errors in the unknown patterns as opposed to the learning patterns used to design the system. Author

N64-25290 TRW Semiconductors Inc., Lawndale, Calif.
PRODUCTION ENGINEERING MEASURE: RELIABILITY THRU PROCESS IMPROVEMENT (2N1506) Sixth Quarterly Report, 30 Sep.–31 Dec. 1963
R. Austin, G. Kamienski, P. Kellow, and I. Massaron [1963] 31 p
(Contract DA-36-039-SC-86742)
(TRWS-3000-43-Q-6; AD-437914)

Evaluation of lead attachment and encapsulation techniques were completed, and a production run was started. Linear life test results indicated a very low failure rate for those improvements incorporated into the 2N1506 production process, and showed a capacity of providing the desired reliability level. Author

N64-25295 Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE: TYPE 2N1814 SILICON ALLOY TRANSISTOR Quarterly Progress Report, 1 Jan.–31 Mar. 1964
T. Csakvari, P. Kannam, G. Mellott, D. Moore, R. Pisarcik et al [1964] 34 p
(Contract DA-36-039-AMC-03617(E))
(QPR-3; AD-601676)

The status of all phases of the reliability improvement program is presented. Results of experimental studies designed to provide information for improved processing techniques are described. Additional information concerning the design of life test equipment and device failure rate is presented. Author

N64-25298 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
EXPERIMENTAL INTEGRATED CIRCUITS FOR SWITCHBOARDS

Russell A. Gilson, Jere W. Hohmann, and Albert L. Bramble
Apr. 1964 22 p ref
(USAELRDL-TR-2447; AD-602149)

Selected silicon integrated circuits designed for switching and multiplexing equipments are investigated under severe temperature and nuclear environments. The amount of temporary and permanent damage is assessed, and the circuits are given a comparative functional test with the discrete component circuits they were designed to replace. Author

N64-25300 Crystalonics, Inc., Cambridge, Mass.
PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND TO INSURE THE RELIABILITY OF THE C600 SERIES FIELD EFFECT TRANSISTORS Quarterly Report, 1 Jan.–31 Mar. 1964
John R. Williams [1964] 34 p
(Contract DA-36-039-AMC-01483(E))
(QR-3; AD-601433)

Improvements were made in wire feed and in the mount holder to facilitate ultrasonic bonding. In addition, slice probing was inaugurated to increase the efficiency of the bonder. A die-to-header bonder was purchased and installed. Best results were obtained by applying the gold directly to the slice and thus eliminating the Si O_2 film. The mask spacings were reduced to take advantage of the improved alignment technology. This has resulted in a significant improvement in the Gm/IA ratio. The mesa etching fixture was installed in the production process. Work on a slice preparation fixture is continuing. A final design of the life test racks was made. Author

N64-25302 Harry Diamond Labs., Washington, D.C.
TRANSIENT BEHAVIOR OF BISTABLE FLUID ELEMENTS
Jorma R. Keto *In its* Proc. of the Fluid Amplification Symp., vol. III May 1964 p 5–26 (See N64-25301 17-11)

A qualitative study was made of the transient behavior of a bistable fluid element when subjected to a suddenly applied input. The correlation of data obtained from pressure transducers and high-speed schlieren photographs shows that the behavior is governed by reflections of pressure waves within pneumatic lines attached to the element. The splitter location, setback, and power jet pressure ratio have relatively minor effect. An oscillator based upon these findings is discussed. Author

N64-25303 Harry Diamond Labs., Washington, D.C.
A SONIC OSCILLATOR
Chris E. Spyropoulos *In its* Proc. of the Fluid Amplification Symp., vol. III 1 May 1964 p 27–52 refs (See N64-25301 17-11)

A bistable pneumatic element was caused to oscillate by providing an external feedback interconnection between its two control nozzles. The effects of oscillator control interconnection length, diameter, and power-jet pressure on oscillator pulse rate were experimentally determined. These experimentally determined oscillator characteristics are compared with the theory. Also, the oscillator control interconnection pressure wave phenomenon is investigated. Author

N64-25317 Microwave Associates, Inc., Burlington, Mass.
KA-BAND CRYSTAL PROTECTOR Quarterly Progress Report, Dec. 15, 1963 – Mar. 15, 1964
Paul Basken [1964] 30 p
(Contract DA-36-039-AMC-00157(E))
(QPR-4; AD-601428)

An analysis is made of two life tests conducted on combination pre-TR-crystal protector TR tubes. The results indicate that the keep alive is the limiting factor of operational life expectancy. Additional work on two- and three-element pre-TR tubes is summarized, and the advantages and drawbacks of the two possible approaches are shown. The problem of high insertion loss of present PIN switches is presented. Methods of improving this loss — in view of the lower isolation needed in a gas-solid state combination device — are discussed. A preliminary life test on such a device shows promising results. Author

N64-25330 Varian Associates, Palo Alto, Calif. Central Research Lab.
SUBSTRUCTURED P-N TUNNEL JUNCTION FOR MICROWAVE GENERATION Final Technical Documentary Report
H. Kroemer Wright-Patterson AFB, Ohio, AF Avionics Lab., Jun. 1964 73 p refs
(Contract AF 33(657)-8874)
(AL-TDR-64-129; AD-436277)

The purpose of this work was to develop a tunnel diode structure that would, within itself, through microminiaturization, incorporate the critical stabilizing circuit. Results of investigations indicate that the difficulties of extending the power capabilities of tunnel diodes at microwave frequencies cannot be readily overcome by going to self-stabilized or substructure devices, and such devices do no longer appear practical. A more promising alternative, still using tunnel diodes, is their use in conjunction with multiterminal Hall insulators. I.v.L

N64-25376 New York U., N.Y. Lab. for Electroscience Research
ON THE INTRINSIC SHORT-CIRCUIT CURRENT GAIN OF DIFFUSED BASE TRANSISTORS Eleventh Scientific Report
John J. Kelly and Mohammed S. Ghausi 14 May 1964 19 p refs
(Contract AF 19(628)-379)
(TR-400-94; AFCRL-64-345; AD-601988)

In this paper, an analytic approximation to the expression for the intrinsic short-circuit current gain of the diffused base transistor in the common base configuration is obtained. The method of approximation uses the product expansion of the transcendental functions. The infinite product expansion shows the effects of all the poles of the gain function. The equations are simple to interpret and give insight into the operation of the transistor in the region above the alpha cutoff frequency. An analytic expression for the single pole approximation with excess phase is also obtained, which method avoids tedious and involved computations made to determine the 3-db frequency and the phase angle at the 3-db frequency or a somewhat higher frequency. The analytic approximate expression for the excess phase and the alpha cutoff frequency can be used to simply and accurately determine these quantities from the physics of the device and from the entire transistor frequency range. Author

N64-25377 Naval Ordnance Lab., White Oak, Md. Air-Ground Explosions Div.
THE USE OF A KNOCK-OFF TUBE AS A QUICK PRESSURE-RELEASE MECHANISM
Robert L. Davis Jul. 1964 77 p refs
(NOLTR-63-134; AD-602198)

The reactor-vessel containment work currently being conducted is dependent largely upon ability to monitor the internal pressure–time histories of dynamically loaded model reactor vessels. These histories are determined through the use of tourmaline piezoelectric gages mounted on the internal walls of the vessel. The need for a calibration system that will accurately relate the output of the piezoelectric gages to known pressures is manifest. Inherent to a piezoelectric gage calibration system is a quick pressure-release mechanism that can release the pressure of a confined fluid very rapidly. The rapid release will produce transient loadings on the gages of the same order of magnitude as those obtained in the model reactor vessels. This report presents an analysis of the use of a knock-off tube as a quick pressure-release mechanism. An equation relating the pressure-release time to the initial conditions of the calibration system was derived and verified, within certain limitations. Author

N64-25385 SFD Labs., Inc., Union, N.J.
RESEARCH AND DEVELOPMENT ON L-BAND CROSSED-FIELD AMPLIFIER CHAIN Semi-Annual Report, Sep. 1963 — Feb. 1964
H. L. Mc Dowell May 1964 63 p
(Contract AF 30(602)-2533; ARPA Order 136-61)
(RADC-TDR-64-236; AD-441972)

A group of six C-design driver tubes was constructed. Outputs of 150-kw peak were obtained over a 100-mc band with 5-kw peak drive. These results were obtained with the tube operated from a d.c. power supply with control electrode turn-off. Life tests have been started, and just under 3,000 hours of life test experience have been accumulated. Author

N64-25407 Illinois U., Urbana Coordinated Science Lab.
PROPERTIES OF CLASSES OF PATHS
W. Mayeda May 1964 15 p refs
(Contract DA-28-043-AMC-00073(E))
(R-212; AD-601155)

This paper gives the properties of a class of paths where each class consists of all possible paths between a pair of vertices in a nonoriented, nonseparable linear graph. It is clear that such properties should be known when one synthesizes an s.c. switching network that satisfies a set of given switching functions. An interesting application of classes of paths is to obtain all possible trees in a linear graph shown at the end of the paper. Author

N64-25447 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELECTRONIC EYE
11 May 1964 5 p Transl. into ENGLISH from Berliner Zeitung (Berlin), 8 Dec. 1963 p 4
(FTD-TT-64-154/172; AD-601758)

An electronic microscope, characterized by its high resolving power, is of special importance to metallurgical research because it works on the basis of ion-emitted secondary emission. This permits the immediate reproduction of a metal surface to be enlarged up to 8,000 times its original size when heated to slightly below its melting point. The microscope can also be used for investigating semiconductor systems because of its dense current ion-beam capability. The pictures produced on the screen can be reproduced cinematographically. With the instrument structures can be viewed that are as small as 1/40,000 mm. The 8,000X magnification power is about 10 times that of the illumination microscope. G.D.B.

N64-25448 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF SCHOOLS OF HIGHER EDUCATION, ELECTROMECHANICS (SELECTED ARTICLES)
B. V. Il'in and N. S. Anishin 21 Feb. 1963 30 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Elektromekhan. (Novocherkassk), no. 6, 1962 p 632–649
(FTD-TT-62-1834/1+2+4; AD-299665)

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2. A PULSE-SEPARATION CIRCUIT FOR A SERVO-SYSTEM N. S. Anishin p 22–27 refs

N64-25456 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A METHOD OF STABILIZING AUTOMATIC CONTROL SYSTEMS OF VARIABLE STRUCTURE WITHOUT USING THE DERIVATIVES OF THE ERROR SIGNAL
S. V. Yemel'yanov and V. A. Taran 16 Dec. 1963 34 p refs Transl. into ENGLISH from Izv. An SSSR, OTN, Tekhn. Kibernetika (USSR), no. 1, 1963 p 155–171
(FTD-TT-63-1110/1+2+4; AD-428711)

An additional correction to a linear automatic control system by varying the structure of the system in accordance with the error and its derivatives can considerably improve the transient qualities. The question of the use of an inertial linear filter, which transforms the error signal, to obtain the law of change in the structure is considered. Author

N64-25465 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THEORY OF REGULATABLE DIRECTIONAL RECEPTION (RNP)
S. A. Nakhamkin 29 Apr. 1964 10 p refs Transl. into ENGLISH from Vopr. Dinamicheskoy Teorii Rasprostraneniya Seysmicheskikh Voln (USSR), No. 6, 1962 p 181–184
(FTD-TT-64-197/1+2+4; AD-600801)

This paper simplifies certain theory relationships based on the principle of the regulatable directional method, further developed on the base of the frequency theory of signals. The theory made it possible to synthesize the regulatable directional reception by determining the necessary parameters. G.D.B.

N64-25482 New York U., N.Y. Lab. for Electroscience Research
PARALLEL CHANNEL MULTILOOP FEEDBACK AMPLIFIERS Eighth Scientific Report

J. Golembeski Nov. 1963 46 p refs
(Contract AF 19(628)-379)
(AFCRL-64-287; TR-400-88; AD-601635)

A class of feedback amplifiers is considered in which a number of stages is connected in parallel with isolation between them, and feedback is applied between various stages. This class of amplifiers is shown to have a gain sensitivity far superior to that found in the more conventional single and multiple loop amplifiers with cascaded stages. An experimental amplifier is described that was designed and constructed to verify the theoretical conclusions, and also to investigate such practical considerations as the isolation problem and restrictions on the choice of feedback network connections. The experimental results correlated well with those expected from theoretical considerations. Author

N64-25494* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
COMPARISON OF NONLINEAR AND LINEAR MULTIRECEIVER DETECTION SYSTEMS
William C. Lindsey Repr. from IEEE Trans. Space Electron. and Telemetry, v. SET-10, no. 1, Mar. 1964 p 10–14 refs
(Contract NAS7-100)
(NASA-CR-56784; JPL-TR-32-597)

This is a discussion of the detection of a binary transmitted signal by both optimum and suboptimum nonlinear and linear multireceivers, in terms of a comparison of their asymptotic performance characteristics. In particular, Turin's nonlinear specular-coherent multireceiver and the nonlinear noncoherent Pierce–Stein multireceiver are considered. The termination error rate characteristics of these units are graphically compared for low and high output signal-to-noise ratios. The performance characteristics of two other coherent linear multireceivers, one optimum and one more easily implemented suboptimum, are derived and compared with the Turin and Pierce–Stein nonlinear multireceivers. The numerical results indicate system design trends and provide information on the degradation or improvement afforded by employing nonlinear detection systems as compared with linear detection systems. IAA

N64-25497 General Instrument Corp., Garden City, N.Y. Capacitor Div.
PRODUCTION ENGINEERING MEASURE FOR THE IMPROVED RELIABILITY OF CAPACITORS, FIXED SOLID ELECTROLYTE, TANTALUM HIGH-RELIABILITY 10MFD-20 VOLT CAPACITORS Second Quarterly Report, 29 Sep.–28 Dec. 1963
Floyd R. Banks, Jr., Edward M. Moss, and A. Di Giacomo [1963] 35 p refs
(Contract DA-36-039-AMC-03622(E))
(QR-2; AD-435810)

Work was performed in five areas of process improvements: (1) anode design; (2) pyrolytic conversion; (3) carbon and silver coating; (4) binder ratios (as part of binder control); and (5) aging. The primary emphasis of the work was upon a detailed assessment, through data analysis and correlation, of the process improvement studies that have been conducted. Author

N64-25513 Rock Island Arsenal Lab., Ill.
EFFECT OF ELECTRICAL INSULATION MATERIALS ON PROTECTIVE METAL FINISHES UNDER CONDITIONS OF HEAT AND MOISTURE
W. F. Garland 22 Aug. 1963 24 p refs
(RIA-64-728; AD-602524) OTS: $1.00

An investigation was made of the effects of certain AIEE Class 0 (90° C) and A (105° C) electrical insulation materials on protective metal finishes. Sleevings, tapes, varnishes, insulated wires, and insulation paper were evaluated in contact with and in confined close proximity to bare steel, uncoated aluminum, anodized aluminum, and cadmium and zinc (with and without chromate treatment). Temperatures and initial relative humidities utilized were 160 ±2° F and 100% R.H., and 200 ±2° F and 50% R.H. Sleeving materials in general were the most corrosive and insulated wires the least corrosive insulation material. Zinc with and without chromate treatment was most susceptible to corrosion by the insulation materials tested, and anodized aluminum the least affected metal. The greatest amount of corrosion occurred at a test temperature of 200° F. Author

N64-25514 General Electric Co., Syracuse, N.Y. Electronics Lab.
FIELD EFFECT TRIODES AND SPACE CHARGE LIMITED TRIODES Final Report, 1 Jun. 1962–31May 1963
J. M. Blank, A. E. Cahill, K. K. Reinhartz, V. A. Russell, W. Tantraporn et al Fort Monmouth, N.J., Army Signal Corps., [1963] 75 p refs
(Contract DA-36-039-SC-90756)
(Rept.-4; AD-442774)

The purpose of this project is the theoretical investigation, design, and development of thin-film metal-dialectric active solid-state devices with usable power gains that are relatively insensitive to temperature changes. A novel conduction mechanism for thin-film field-effect triodes is presented. New experimental findings seem to substantiate a trap emptying mechanism. The results of experiments in varying SiO and CdS thickness in field-effect triodes are shown. Some theoretical considerations for observation of space charge limited current in CdS films are discussed. The methods of fabrication of SCL devices are presented, and a new study of SCL current in films and CdS sandwich structures is discussed. A post-deposition treatment of cadmium sulfide films is outlined, and results are presented. Preparation of CdS films at various substrate temperatures and in ultrahigh vacuum is discussed. The use of molecular beam evaporation sources is also discussed. Author

N64-25520 New Mexico U., Albuquerque Engineering Experiment Station
ELECTRIC FIELDS FROM AIRBORNE VERTICAL AND HORIZONTAL DIPOLES AT VERY-LOW FREQUENCIES
A. H. Garry Gibson Apr. 1964 230 p refs
(Contract Nonr-2798(01)FBM)
(EE-105; AD-439649)

The method of analysis used in this paper is a ray theory based on the work of H. Bremmer, but modified according to Wait to extend the method of analysis past the critical caustic zone, the region where the rays are tangent to the earth's surface and where Bremmer's solution fails. A combination of the vertical and horizontal electric dipoles is considered as a transmitting antenna at various elevations above the surface of the earth. This antenna, having conducted the electric field into the earth, is analyzed taking into account a spherical, conducting earth surrounded by a concentric, anisotropic, homogeneous, lossy ionosphere. The geometry of the ionosphere is modified to simulate a day and night zone to determine the effect of propagating from one region to another. G.D.B.

N64-25523 Microwave Associates, Inc., Burlington, Mass.
C- AND Ku-BAND SEMICONDUCTOR TR DEVICES Second Quarterly Progress Report, 1 Oct. – 30 Dec. 1963
R. H. Brunton [1963] 28 p
(Contract DA-36-039-AMC-03187(E))
(Rept.-2; AD-438026)

The work performed on the Ku-band investigation of ridge waveguide with integrated diodes was concluded. Tests during this report interval were discouraging because of the extremely fragile structure of the integrated varactor junction. Ku-band full- and reduced-height waveguide diode mounts with coaxial shunt stubs were fabricated and evaluated. Successful results were obtained with both varactor and PIN diodes in the Pill II ceramic package. Test results showing individual, as well as, dual diode switching are shown in the technical section of this report. The results of tests to evaluate high burnout crystal detectors are also reported. Author

N64-25527 Microwave Associates, Inc., Burlington, Mass.
BROADBAND MICROWAVE POWER LIMITERS Third Quarterly Report, 1 Jan.–31 Mar. 1964
R. Tenenholtz [1964] 24 p
(Contract NObsr-89462)
(QPR-3; AD-439236)

Theoretical aspects dealing with scaling low-power prototype limiter designs to higher power versions are covered. In addition, experimental results covering various portions of anticipated final design configurations are also included. This deals with such items as bias crystals and insulated diode mounts. In addition, 1-kw operation performance on an L/S-band unit is described. Author

N64-25545 Cinch Mfg. Co., Chicago, Ill.
PRINTED CIRCUIT CONNECTORS FOR MICROASSEMBLIES Final Progress Report, 1 Feb. 1963–1 Feb. 1964
Howard E. Dwan [1964] 90 p
(Contract DA-36-039-AMC-00122(E))
(Rept.-4; AD-437234)

The objective of this study was the development of printed-circuit connectors for plug-in microassemblies. The study was conducted in two tasks. Task A provided for the development of a contact for a female printed-circuit receptacle whose overall height does not exceed 0.100 in. The receptacle contacts are capable of mating with established hermetic microassembly pin terminations (0.016-in. to 0.020-in. diam) spaced on a 0.075-in. grid. Task B provided for the development of feasibility models of printed circuit connectors for encapsulated microassemblies having 36 and 80 conductor ribbons 0.010-in. by 0.002-in. extending from the base. The ribbons protrude from the base on 0.025-in. centers around 0.310-in. and 0.600-in. squares located symmetrically within the square area of the base. Basic design requirements, contact designs, and connector concepts developed, and background information showing the relationships of these developments with the microcircuit module program are discussed. Author

N64-25581 Martin Co., Baltimore, Md. Nuclear Div.
THERMIONIC DOUBLE-DIODE PROGRAM Quarterly Technical Progress Report, Mar. 16 – Jun. 15, 1964
T. H. Cox, R. L. Hobbs, W. J. Levedahl, J. D. Long, J. E. Monroe et al 30 Jun. 1964 19 p refs
(Contract AF 33(615)-1289)
(MND-3149-1; AD-601917)

Engineering design of the improved double-diode module was completed. Design refinements and improvements on the fueled emitter design, module configuration, design features affecting performance, manufacturing techniques, and instrumentation were incorporated into the previous double-diode module design. Manufacturing drawings were completed and released. Material procurement was completed, and fabrication of details for all components for the modules and test fixtures and instrumentation was initiated. Fabrication of the fueled emitters for the thermal endurance and vacuum tests has been started. Author

N64-25583 General Electric Co., Syracuse, N.Y. Semiconductor Products Dept.
PRODUCTION ENGINEERING MEASURE: SILICON GROWN DIFFUSED TRANSISTOR, TYPE 2N336 Final Report
P. W. Olski 30 Apr. 1964 239 p
(Contract DA-36-039-SC-86727(E))
(AD-601889)

Discussed are the improved passivation and encapsulation techniques, as well as the evaluation of the effectiveness of these techniques, the reliability estimate as a function of stress, and a multilevel high-reliability specification, which characterizes the device for high-reliability applications. All program objectives were met or bettered. The expected failure rate, at the upper 90% confidence limit as extrapolated using least square techniques and the Arrhenius failure model, is shown to be 0.01% per 1,000 hours operation at 235 mw at 25° C ambient temperature. Author

N64-25585 International Resistance Co., Philadelphia, Pa.
RELIABLE, LOW COST, STABLE RESISTORS GENERAL PURPOSE Quarterly Report, Nov. 1, 1963–Jan. 31, 1964
Sylvester S. Mattie and James W. Winkler [1964] 40 p
(Contract DA-36-039-AMC-02202(E))
(QR-3; AD-601584)

The qualification test sequences are complete with the exception of 1,000-hour load life on the 2.7Ω and 40Ω units. These tests have shown a minor problem area in wet insulation resistance. They also indicate temperature coefficient capability of 750/ppm in the high ranges as was initially envisaged. The temperature load matrix is proceeding according to schedule, with some of the units going into their second 1000-hour period. To date, the units seem to indicate a full load capability at temperatures in excess of the targeted 85° C. The moisture load matrix has, in general, accumulated over 250 hours of data for all test groups, with some groups well in excess of this amount. Some problem areas have been identified in this matrix. In addition, an accelerated moisture load test is being run to further identify these problem areas. Author

N64-25588 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Sixth Quarterly Progress Report, Oct. 1 – Dec. 30, 1963
Milt Le Baron [1963] 10 p
(Contract DA-36-039-SC-86730)
(Rept.-03-64-15; AD-607283)

The purpose of this program is to evaluate and adopt proposed process improvements toward achieving a maximum failure rate of 0.01% per 1,000 hours at a 90% confidence level for silicon triple-diffused transistor-type 2N656. Sustaining process engineering has maintained satisfactory control of the 2N656 series. The stress tests on 1,100 production planar devices were completed, and the data are being analyzed. (The test conditions were established after analyzing the previously reported mesa step stress test results, along with the results of several small preliminary tests on the planar devices.) I.v.L.

N64-25597 ITT Gilfillan, Inc., Los Angeles, Calif.
STUDY OF A MULTIPLATE ANTENNA CONTROL SYSTEM Final Report
G. Epstein and J. L. Dautremont, Jr. 14 May 1964 117 p
(Contract AF 19(628)-2948)
(AFCRL-TDR-64-255; AD-440040)

Both digital and analog control methods are investigated, with the emphasis placed on providing the most economical and flexible means of plate control. A central digital system is described in detail. This system provides digital incremental information through a network of distribution centers to stepping devices at the individual plates of the antenna. The proposed system is very flexible, permitting the generation of arbitrary radiation patterns. Author

N64-25600 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
FORMATION OF DIELECTRIC FILMS BY ULTRAVIOLET PHOTOLYSIS I. SEVERAL ORGANIC MONOMERS
L. V. Gregor and H. L. Mc Gee 14 Mar. 1963 29 p refs
(RC-900)

Thin dielectric films have been deposited on metallic surfaces by ultraviolet photolysis of several organic monomer vapors at pressures of a few mm Hg in the presence of nitromethane. By regulating the surface temperature, relatively high rates of film deposition of 2.5 A/sec have been attained. The films have been used to prepare capacitors with high dielectric strengths ($>10^6$ v/cm) and reliability when film thickness exceeds 200 to 300 A. The logarithm of the film growth is a linear function of the reciprocal absolute temperature of the substrate, increasing as the temperature decreases. The deposition rate increases with increasing monomer partial pressure, and is proportional to illumination time. The formation of the polymer film is discussed in terms of a free radical polymerization mechanism, and some of the properties of the film indicate that cross-linking may occur during polymerization. Author

N64-25602 Lincoln Lab., Mass. Inst. of Tech., Lexington
MILLSTONE HILL RADAR STATION RESULTS OF LONG-BASELINE RADAR INTERFEROMETER STUDIES
E. Gehrels 7 Nov. 1963 53 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-566; TR-335; AD-438425)

The Millstone–Lexington interferometer is a radar interferometer consisting of the Millstone radar transmitter, antenna, and receiver plus an auxiliary receiver station at Lexington, 13.7 nautical miles away. The final IF output of the Millstone receiver and a phase reference for the receiver's local-oscillator frequencies are transmitted to Lexington via a combination of a UHF and a microwave link. The rate of change in the phase of the signal received at Lexington with a 28-ft dish is compared with that received at Milistone to determine the angular velocity of a target. The phase stability of the interferometer system (including the effects of propagation over the UHF and the microwave links) is currently better than $\pm 4°$ over a 10-min period. In addition to these internal system errors, there are phase errors caused by the irregularities in the propagating media (tropospheric and ionospheric turbulence) and the phase errors caused by the irregularities in the reflection pattern of a tumbling object (target scintillation). Author

N64-25613 Columbia U., New York, N.Y. Electronics Research Labs.
DELAY LINE FILTERS FOR FREQUENCY MULTIPLIERS Technical Report T-1/193
John H. Wuorinen, Jr. 1 Jul. 1963 116 p refs
(Contract AF 49(638)1113; ARPA Order 279)
(CU-20-63-AF-1113-ERL; AD-439279)

The results of a theoretical investigation of the performance of delay line filters are presented. The use of filters built up from electrical delay lines is suggested for applications requiring long frequency multiplier chains with a high degree of phase linearity. A Fourier approach to filter synthesis results in an arbitrary amplitude response with linear phase, but requires an infinite number of delays. A synthesis procedure is presented that is useful when the number of delays is limited. This procedure leads to a straightforward design when applied to the special class of filters for frequency multipliers. The perturbations of phase linearity and rejection properties resulting from small imperfections in the ideal filter are derived. Small errors in the individual delays are compensated for, the residual departure from the ideal case is shown to lead to phase nonlinearities of small magnitude. Author

N64-25624 Little (Arthur D.) Inc., Cambridge, Mass.
THEORY OF ELECTRICAL CONDUCTANCE IN ACIDIC, AQUEQUS SOLUTIONS
R. A. Horne 15 May 1964 22 p refs Submitted for Publication
(Contract Nonr-4424(00))
(TR-1; AD-439341)

Protonic conduction occurs by the Grotthuss mechanism. Below about 0.001m HCl, the lengths of the Grotthuss chains are determined by the temperature, but over the range 0.001m to about 0.5m, the chains are principally disrupted by other protons; thus in this range the chain length and the equivalent conductance depend on the cube root of the concentration. An Arrhenius-type equation is developed for describing the concentration dependence of the conductance, which yields values in agreement with experiment to within 1% over the range 5° to 65° C and up to 0.4m. The activation energy that appears in the chain-terminating terms of this equation is that of "hole" formation in the solvent water. Author

N64-25631 Calvin Coll., Grand Rapids, Mich.
THE FORMATION OF THIN ANODIC FILMS OF SILVER OXIDE
Thedford P. Dirkse and J. Barry De Roos 1 Jan. 1964 15 p refs
(Contract Nonr-1682(02))
(TR-1; AD-438188)

The formation of thin anodic films of silver oxide has been studied by means of a constant current technique. The results indicate that this is a diffusion-controlled process involving the hydroxide ion. The study was carried out at room temperature and over a range of potassium hydroxide concentrations. Author

N64-25632 Westinghouse Electric Corp., Pittsburgh, Pa. Molecular Electronics Div.
FUNCTIONAL ELECTRONIC BLOCKS MANUFACTURING METHODS PROGRAM. PART II: BLOCK EVALUATION PROGRAM Interim Technical Progress Report No. 6
Wright-Patterson AFB, Ohio, ASD [1963] 106 p
(Contract AF 33(657)-8913)
(ASD-7-861-4; AD-437974)

Data were obtained in the following areas: (1) gain characteristics versus frequency, temperature, and supply voltage; (2) gain control characteristic versus frequency, supply voltage, signal level, and temperature; (3) block-to-block variations in gain, Y parameters, and d.c. operating levels; (4) saturation characteristics versus signal frequency and temperature; (5) Y parameter data versus frequency and supply voltage; and (6)

d.c. operating point stability versus temperature. Details of the test setups employed and the actual test results are presented. R.T.K.

N64-25640 Utah U., Salt Lake City Microwave Devices Lab.
MICROWAVE DEVICES LABORATORY Consolidated Quarterly Report for the Period October 1, 1963 to December 31, 1963
31 Dec. 1963 97 p
(Contracts Nonr-1288(05); AF 04(647)-745; (AF 33(657)-8677; Grants NSF-6-15017; NSF-GP-843)
(MDL-Q7; AD-434708)

This report discusses studies of electron-beam devices, solid-state devices, and plasma, which are aimed at extending the useful frequency spectrum into the range from microwave frequency to optical frequencies and at improving existing devices and techniques in the microwave spectrum. I.v.L.

N64-25653 Comitato Nazionale Per L'Energia Nucleare, Frascati (Italy)
A NEW BILATERAL FAST LINEAR GATE CIRCUIT
M. Coli and S. Lupini 20 Mar. 1964 8 p refs *Its* Nota Interna No. 242
(LNF-64/18)

A linear gate for 1 nanosec minimum width pulse is described. The minimum gate duration is 5 nanosec, and the rejection ratio for nongated pulses is 30 db at maximum amplitude of 120-ma output pulse. Attentuation of allowed pulses is 0.7 db. A gating pulse generator is also described, capable of repetition rates up to 100 mc. Author

N64-25664 International Business Machines Corp., Yorktown Heights, N.Y.
FORMATION OF THIN DIELECTRIC FILMS BY ULTRAVIOLET PHOTOLYSIS. II ACROLEIN
L V. Gregor and H. L. Mc Gee 17 May 1963 27 p refs
(RC-946)

Ultraviolet photolysis of acrolein vapor results in polymerization of the monomer on metallic surfaces. The thin polymer film behaves as a dielectric, and the rate of reaction can thus be studied by using the film as the dielectric medium in a parallel-plate capacitor. The rate of film growth was studied as a function of monomer pressure, substrate temperature, illumination time, and light intensity. The dielectric properties of the film were studied, and evidence was obtained to show that the polymer possesses a cross-linked structure. The reaction is discussed in terms of a free-radical addition polymerization mechanism. The results are in agreement with the proposed mechanism, and the rate law is of the form

$$R = k_2(k_1/k_3)^{1/2} f(I)^{1/2}[M]$$

up to monomer partial pressures of 5-mm Hg. The rate-determining step is presumably the reaction of an adsorbed monomer molecule with an active site, and the activation energy for this step is estimated to be at least 63 kcal/mole. Author

N64-25675 Illinois U., Urbana Electrical Engineering Research Lab.
RESEARCH STUDIES ON PROBLEMS RELATED TO ANTENNAS
31 Jan. 1963 52 p refs
(Contract AF 33(657)-10474)
(QR-1; AD-296537)

Research in the following areas is reported: (1) radiation from periodic structures; (2) log-periodic cavity-backed slot antennas; (3) log-periodic magnetic-current antennas; (4) log-spiral antennas; (5) log-periodic zigzag antennas; (6) an integrated antenna amplifier; (7) collecting systems containing nonlinear and/or active elements; (8) wave propagation along helical conductors; (9) an investigation of a class of periodic structures for wideband antenna applications; (10) focusing of radiation from a bunched Cerenkov beam; (11) transmission between antennas when the far-field approximation does not apply; (12) a radiating lens illuminated from a Goubau beam waveguide; (13) the properties and uses of zone phase plates; and (14) the focusing properties of metal-lens antennas. Also, a survey was conducted to determine the literature available on the subjects of millimeter wave transmission and radiation. I.v.L.

N64-25695 California U., Berkeley Electronics Research Lab.
[ELECTRONIC RESEARCH IN CIRCUIT THEORY, STREAMS AND INTERACTION, PLASMAS, RADIATION AND PROPAGATION, AND SOLID STATE SYSTEMS] Consolidated Quarterly Progress Report
D. J. Angelakos et al 15 Feb. 1964 100 p refs
(QPR-12; AD-434238)

This series of research projects is discussed in terms of the research personnel, contracts and grants, technical publications, and research areas. These areas of research include bioelectronics, circuit theory, electron streams and interactions, plasmas, radiation and propagation, solid-state electronics, and various control systems. Each project is briefly discussed under the general categories named. G.D.B.

N64-25700 Edgerton, Germeshausen, and Grier, Inc., Boston, Mass.
AN EVALUATION OF THE CBS, TYPE CL-1129, 24-INCH PHOTOMULTIPLIER TUBE
D. A. Helm and P. H. Zajattaro 4 Jun. 1964 82 p refs
(Contract AF 33(657)-12291)
(B-2764; AD-442498)

This program was undertaken to evaluate the utility of the CBS, Type CL-1129, 24-in.-multiplier tube for use as a detector element for a direct optical detection system. The tube does, in fact, possess a large cathode with good sensitivity and current density capabilities. However, due to fundamental space charge limitation, these parameters cannot be utilized simultaneously. Therefore, the tube, in its present configuration, does not fulfill the requirements for a direct-view optical detection system. The shortcomings of the tube are not basic. In addition to the space charge limitation, leakage between the cathode and the first dynode limits the usefulness of the tube at low light levels. The present limitation due to power dissipation in the first dynode is a secondary result of the space charge limitation. Through a suitable redesign of the tube, it seems feasible to produce a photomultiplier that does meet the requirements for the specified detection system. Before such a program is undertaken, however, it is recommended that the basic requirements for the detector elements of the detector system be reviewed with the purpose of determining the utility of a photomultiplier for this application. I.v.L.

N64-25704 Technical Research Group, Inc., Melville, N.Y.
DEVELOPMENT OF A LOW-NOISE MILLIMETER-WAVE PARAMETRIC AMPLIFIER Third Quarterly Progress Report, 1 Jan. – 1 Apr. 1964
J. Kliphuis and D. Neuf Apr. 1964 34 p refs
(Contract DA-36-039-AMC-02365(E))
(Rept.-3; AD-602169)

The self-resonant frequency of an unpackaged GaAs varactor die was measured and found to be 44 Gc. This result is encouraging because the optimum idler frequency required for minimum amplifier excess noise temperature is approximately 40 Gc. As a preliminary step in the development of a 94-Gc Y-junction circulator, a unit having a 7% bandwidth has been extremely fabricated and tested at 35 Gc. The use of a laser beam welder appears to be a practical technique for bonding ribbons to expremely small mesa contracts, even after the die is etched. Author

N64-25707* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE USE OF SOLID CIRCUITS IN SATELLITE INSTRUMENTATION
Edgar G. Bush Washington, NASA July 1964 11 p
(NASA-TN-D-1758) OTS: $0.50

An optical aspect computer for the forthcoming Interplanetary Monitoring Probe has been designed and constructed with SN510 and SN514 solid circuits used as binary counters, flip-flops, and inhibiting circuits. The results obtained during the development and testing of the computer indicated that these devices have advantages over other types of logic components and are particularly suitable for spacecraft flight hardware applications. Author

N64-25721 General Electric Co., Syracuse, N.Y. Electronics Lab.
TUNNEL DIODES FOR PHASED ARRAY RADAR Third Quarterly Progress Report, 20 Jan.–10 Apr. 1964
[1964] 56 p
(Contract NObsr-98328)
(QPR-3; AD-436875)

Work on tunnel diodes for phased array radar includes device development for both germanium and gallium antimonide, high-frequency measurements, realization of equivalent circuit parameters from the high-frequency admittance plots, the measurement of the S-band noise figure, S-band converter work, and the initial design of a C-band amplifier. Major effort in the device development work was directed toward the production of better germanium diodes. High-frequency measurements of the devices were continued using the direct method. Considerable effort was spent in analyzing the results of these high-frequency measurements with the objective of realizing a valid, high-frequency equivalent circuit of the device. A new and novel method was conceived for the analysis. A noise figure measurement on a newly built S-band amplifier was made and found to be about 4.0 db. An S-band self-oscillating converter module, together with a mixer unit with external local oscillator power using the same module, was tested. Improvement in the noise figure was achieved. I.v.L.

N64-25722 Bendix Field Engineering Corp., Owings Mills, Md.
VALIDATION TEST OF MTI RECEIVER P. O. AN/FPS-66
14 Feb. 1964 124 p
(Contract AF 30(602)-2536)
(RADC-TDR-64-84; AD-435739)

This report is made up of three basic sections that comprise the collection of data for the MTI System, which is a part of the AN/FPS-66 radar set. General information, operational characteristics of the MTI system, and description of tests are given. Author

N64-25723 New Mexico State U., University Park Physical Science Lab.
FLUSH AND NONFLUSH MOUNTED TELEMETRY ANTENNAS, FLUSH MOUNTED COMMAND CONTROL ANTENNAS, S-BAND AND C-BAND BEACON TRANSPONDER ANTENNAS, AND ANTENNA SYSTEMS FOR SPECIFIC MISSILES, PROBES AND SATELLITES Final Report
Henry D. Weinschel 15 Oct. 1963 355 p refs
(Contract AF 19(604)-6198)
(AFCRL-63-594, AD-432162)

Progress is reviewed, and short descriptions of antenna systems are included. A photograph and/or assembly drawing is provided for each antenna discussed. The electrical characteristics of the various antenna types are presented by impedance versus frequency curves, by VSWR versus frequency curves, by patterns of the principle plane cuts, and by power contour plots. The various antenna series are discussed with the emphasis on the distinguishing feature of the antenna models. Author

N64-25726 Lincoln Lab., Mass. Inst. of Tech., Lexington
RADIO PHYSICS Quarterly Progress Report, 1 Feb.–30 Apr. 1964
J. W. Meyer 9 Jun. 1964 16 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-331; AD-441192)

The current status includes the following: (1) In the Millstone Hill surveillance technique, a polarization control system was designed for the L-band radar. A new real-time coherent integration program for the CG24 computer was completed, checked out, and used in observations of Venus and Mercury. Approximately 720 hours of ionospheric backscatter data were reduced to give electron density, electron temperature (T_e), ion temperature (T_i), and the ratio T_e/T_i as functions of time and height. The complete H-line absorption spectrum of Cassiopeia A was measured. Thirty-seven tracking operations were conducted on 15 different satellite objects. (2) More than 60 daily solar radar observations were made. A computer program was devised to process solar data obtained from 20 range integrators as a function of doppler shift. (3) The experimental investigation of the propagation of spherical shock waves into weakly ionized gases was completed. Also, the construction status of the Haystack radar is discussed. I.v.L.

N64-25730 Utah U., Salt Lake City Upper Air Research Lab.
PROGRESSIVE DEVELOPMENTS IN THE DESIGN OF AN AIRBORNE UHF TRANSMITTER FOR THE FALLING SPHERE EXPERIMENT Technical Report No. 1
Jon. L. Cross 9 Dec. 1963 80 p refs
(Contract AF 19(604)-6658)
(AFRCL-63-922; AD-601818)

The development of a pulsed telemetry transmitter that is to be incorporated into a 7-in. sphere containing instrumentation for measuring high-altitude air density is discussed. The theory and design criteria are presented of a 30-w pulse-modulated transmitter that uses ceramic planar triode tubes with a coaxial resonator. J.L.D.

N64-25758 Avco-Everett Research Lab, Everett, Mass.
AN EXPERIMENTAL MEASUREMENT OF THE DEPENDENCE OF THE H-I CURVE OF NB-ZR WIRE ON TEMPERATURE
R. D. Cummings and W. N. Latham Jul. 1964 9 p
(Contract AF 04(694)-414)
(AMP-141; BSD-TDR-64-87; AD-602424)

This report contains the description of an apparatus to measure the variation with temperature of the current carrying capacity of short samples of superconducting material as a function of externally applied magnetic field. Included in the report are data for the following samples: Westinghouse, Nb-25% Zr, 0.010 in. diam wire; Westinghouse, Nb-25% Zr, 0.010 in. diam wire; and Supercon, Nb-33% Zr 0.010 in. diam wire. Author

N64-25778 Columbia U., New York, N.Y. Stanley-Thompson Lab.

ELECTRICAL PHENOMENA AT THE ICE/WATER INTERFACE

Jack H. Schulman and H. C. Parreira Jun. 1964 25 p refs
(Contract Nonr-266(64))
(TR-1)

The experimental equipment designed for investigating electric phenomena that occur at the ice–water interphase is described. This equipment consists of an automatic apparatus for recording streaming potentials on ice–water systems, the main components of which are the streaming potential cell, the solution reservoirs and pressure ballast, the pressure gage, pressure transducer, and the electronic circuit, and an apparatus for producing and measuring electric potentials at the ice–water interphase during freezing. The main components of the latter are the freezing potential cell, the freezing well, and the measuring and recording devices. This equipment will be used to study the electric potentials generated whenever liquid water is forced through ice capillaries under pressure gradients (streaming potentials), and the electric potentials that appear during the freezing of water of dilute aqueous solutions (freezing potentials). I.v.L.

N64-25800 George Washington U., Washington, D.C. Human Resources Research Office

FORECAST SYSTEMS ANALYSIS AND TRAINING METHODS FOR ELECTRONICS MAINTENANCE TRAINING

Edgar L. Shriver, C. Dennis Fink, and Robert C. Trexler May 1964 53 p refs
(Contract DA-44-188-ARO-2)
(RR-13; AD-441248)

The research presented in this report was directed primarily toward troubleshooting electronic weapon systems. Its principal findings bear upon three interconnected problems—developing training and job methods and aids, such as mockups, substitute or obsolete equipment, and block diagrams for troubleshooting; and planning and managing personnel, with special reference to transition training from old to new weapon systems. Results of the studies made suggest that training based on FORECAST methods of analysis produces men capable of effectively performing the job with less training time than that needed for traditional instruction in electronics maintenance. Author

N64-25803* General Electric Co., Waynesboro, Va.

STUDY OF CAPACITORS FOR STATIC INVERTERS AND CONVERTERS Third Quarterly Report, 16 Feb.–16 May 1964

J. F. Scoville [1964] 35 p
(Contract NAS3-2788)
(NASA-CR-54075; R63SCW-31-3) OTS: $3.60

The objectives of this study are to establish capacitor a.c. characteristics and ratings for reliable operation in aerospace static inverter and converter applications, and to facilitate the proper capacitor selection to minimize volume and weight consistent with maximum equipment performance and reliability. This study was initiated because the significant capacitor volume, weight, power loss, and reliability factors in space applications of static inverters and converters are at a premium and there are inadequate capacitor a.c. data and characteristics to enable consistent performance predictions. Capacitor power factor and capacitance measurements at 25° C, commutating capacitor loss measurements while operating in an inverter, and analysis of commutating capacitor losses are all discussed. Author

N64-25819 Microwave Associates, Inc., Burlington, Mass.

INVESTIGATION OF HIGH POWER GASEOUS ELECTRONICS Quarterly Progress Report, 16 Nov. 1963–15 Feb. 1964

H. S. Maddix and T. Gregory [1964] 31 p refs
(Contract DA-36-039-AMC-00097(E))
(QPR-5; AD-438865; SCL-5794)

A theoretical expression is derived for the cleanup of gas at the interface between a high power microwave discharge and a dielectric surface. Gas cleanup is described in terms of sticking times and the energy of activation for diffusion into the solid of gas trapped at the surface. Agreement was obtained between theory and experiment for the cleanup of helium, neon, and argon at a quartz surface. Author

N64-25821 Polarad Electronics Corp., Long Island City, N.Y. Polarad Electronics Instruments Div.

RADIO INTERFERENCE MEASURING SET AN/TRM-6 (XA-3) Final Engineering Report

Sol Abrams Wright-Patterson AFB, Ohio, AF Avionics Lab., Mar. 1964 42 p refs
(Contract AF 33(600)-41420)
(AL-TDR-64-30; AD-437907)

The purpose of the work was to extend the frequency range of radio interference measuring set AN/TRM-6(XA-2) from its upper limit of 10 gc to a new upper limit of 21 gc. This purpose was accomplished by the design, development, and prototype production of two additional calibrator converter tuning units FR-160(XA-1)/TRM-6 and FR-161(XA-1)TRM-6 that covered the frequency range of 10 to 21 gc and the required waveguide and antenna components for their operation. The added units and components are compatible with AN/TRM-6(XA-2), and the resulting assemblage, which covers the frequency range from 1 to 21 gc, is identified as AN/TRM-6 (XA-3). Author

N64-25832 Ohio State U. Research Foundation, Columbus Antenna Lab.

AN APPLICATION OF MODIFIED GEOMETRICAL OPTICS METHOD FOR BISTATIC RADAR CROSS SECTIONS OF DIELECTRIC BODIES Scientific Report No. 24

Tadasu Kawano and Leon Peters, Jr. 15 Nov. 1963 51 p refs
(Contract AF 19(604)-7270)
(AFCRL-64-296; Rept.-1116-39; AD-439378)

The formulas for the bistatic radar cross section of a dielectric sphere whose specific dielectric constant is less than unity are derived by the application of modified geometrical optics method. Numerical calculations for the bistatic radar cross sections for both H-plane and E-plane are made for the spheres of three different radii. The results compare favorably with those obtained from the boundary-value solution except for the case of a small diameter. The formulas for the contribution of the through wave to the bistatic radar cross section are derived by means of aperture field method, and the results of numerical calculation for the case of small diameter are favorably corrected by the use of those formulas. A correction for the abrupt change of the field intensity of the externally reflected wave is also made by using physical optics. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see*: 06 Auxiliary Systems.

N64-24384 Massachusetts Inst. of Tech., Cambridge Aerophysics Lab.
RECENT ADVANCES IN THE DEVELOPMENT OF A MAGNETIC SUSPENSION AND BALANCE SYSTEM FOR WIND TUNNELS Interim Technical Report, Aug. 1961 – Aug. 1962
Eugene Covert and Edward Lee Tilton, III Wright-Patterson AFB, Ohio, ARL. Dec. 1963 31 p refs
(Contract AF 33(616)-7023)
(ARL-63-235; AD-437265)

This report presents a discussion of the studies related to the development of a magnetic model suspension system. It includes a description of an initial calibration procedure and a procedure for controlling the roll degree of freedom of the model. Particular attention is given to the discussion of low-density, high-temperature limits of the system. A discussion of schlieren optical systems is also presented. Author

N64-24576 Joint Publications Research Service, Washington, D.C.
ARC FURNACES AND ELECTRONIC SMELTING
M. Ya. Smelyanskiy, V. A. Boyarshinov, K. D. Gutterman, L. G. Trachev, and V. P. Tsishevskiy 26 May 1964 65 p refs Transl. into ENGLISH of Chapters 3 and 6 from the Book "Dugovye Vakuumnye Pechi I Elektronnye Plavil'nye Ustanovski" Moscow, Publishing House of Met. Lit., 1962 p 76–114, 188–206
(JPRS-24753; OTS-64-31326) OTS: $1.75

CONTENTS:
1. DESIGN OF VACUUM ARC FURNACES p 1–43 refs (See N64-24577 17-17)
2. ELECTRONIC MELTING UNITS p 44–62 (See N64-24578 17-10)

N64-24577 Joint Publications Research Service, Washington, D.C.
DESIGN OF VACUUM ARC FURNACES
In its Arc Furnaces and Electron. Smelting 26 May 1964 p 1–43 refs (See N64-24576 17-10) OTS: $1.75

The design and construction of a vacuum arc furnace that uses a consumable electrode are presented. Design factors are considered for the furnace frame, combustion chamber, observation system, working chamber, electrode moving mechanism, ingot unloading mechanism, crystallizer, solenoids, and vacuum equipment. A description is included of some types of vacuum arc furnaces currently in use in Soviet industries. D.S.G.

N64-24734 Avco Corp., Wilmington, Mass.
THE AVCO RAD VERTICAL RANGE
Joseph F. Clougherty *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 223–228 (See N64-24712 17-08)

Presently existing radar cross-section measurement facilities are, for the most part, of the horizontal range type. There are several problems associated with the operation of a horizontal range that are especially bothersome when making low radar cross-section measurements. They are variation in illumination of the vehicle because of the presence of ground reflections, the possibility of illumination by multiple scattering, and the "background" problem, i.e., the level of the return from the target support when the target is not present. In many cases, the radar cross section of the target support can equal or exceed the return from the target whose radar cross section is to be measured. The Avco RAD full-scale vertical radar cross section range described offers the solution to these problems. Author

N64-24735 Electronic Space Structures Corp., West Concord, Mass.
THE RADAR REFLECTIVITY MEASUREMENT FACILITY AT ELECTRONIC SPACE STRUCTURES CORPORATION
Albert Cohen and Adam P. Smolski *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 229–232 refs (See N64-24712 17-08)

The dominating feature of the facility is the ground plane range–approximately 2,000 ft long, 400 ft wide, and graded to a true plane. The ground-plane technique essentially eliminates the deleterious effect of random reflections commonly observed in the general test facility. G.D.B.

N64-24736 Aeronutronic, Newport Beach, Calif.
AERONUTRONIC MICROWAVE REFLECTIVITY FACILITY
Harold G. Collins *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 233–239 refs (See N64-24712 17-08)

This paper describes an indoor anechoic chamber measurement site and accompanying instrumentation. A microwave system, its measurement accuracy, and results of facility performance are also presented. Author

N64-24740 Ohio State U., Columbus Antenna Lab.
EXPERIMENTAL REFLECTIVITY FACILITIES
Robert J. Garbacz *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 252–265 refs (See N64-24712 17-08)

Brief descriptions of each range are given and all pertinent specifications are summarized in table form. The anechoic chamber is discussed. K- and KA-band radar echo recording systems are described. Outdoor CW facilities and radar systems for terrain scattering measurements are also described. G.D.B.

N64-24741 Boeing Co., Seattle, Wash. Aero-Space Div.
SCATTERING RANGE—THE BOEING COMPANY
W. P. Hansen, Jr. AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 266–269 ref (See N64-24712 17-08)

A description of scattering range facilities is presented. The facility includes image-plane ranges, an indoor range in an anechoic chamber, and outdoor ranges. Frequencies of operation are from 1 to 10 Gc in various bands. CW operation is used for all facilities. For accurate measurements, maximum model dimensions are limited to between 10 and 20 wavelengths, depending on frequency. Author

N64-24742 Radio Corp. of America, Burlington, Mass.
RCA DYNAMIC BACKSCATTER TESTING RANGE
M. H. Hellman and J. M. Jarema *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 270–273 (See N64-24712 17-08)
(Sponsored by AF)

This testing range was designed and constructed for use in evaluating the performance of radar systems under dynamic

conditions, as against the usual backscatter range designed to measure the cross-section characteristics of targets. Target characteristics are determined indirectly from radar performance. Typical of the parameters measured on the range are the angle tracking variations of a pulse-type fire control radar and range output signal of an FM-CW type radar when performing against full-scale models of satellites. Both the translation and rotation dynamics of the satellite targets are controllable. G.D.B.

N64-24743 Teledyne Systems Corp., Hawthorne, Calif.
OUTDOOR PULSED RADAR REFLECTIVITY RANGE
Robert E. Honer and William D. Fortner *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 274–285 refs (See N64-24712 17-08)

An outdoor pulsed radar reflectivity range is described. Long and short pulse radars are discussed. The geometry of the range is examined, and the flare spot measurement technique is described. G.D.B.

N64-24746 Radiation, Inc., Melbourne, Fla.
STATIC RADAR REFLECTIVITY MEASUREMENT FACILITIES AT RADIATION INCORPORATED
J. E. Landfried and W. L. Williamson *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 299–302 (See N64-24712 17-08)

The static radar reflectivity measuremegt facilities are described with details of system parameters, range layout, and target support techniques. The facility provides measurement capabilities for frequency coverage from 0.3 to 24 kmc with selectable polarizations, a wide range of target sizes and weights, operating ranges up to 2,000 ft for monostatic and bistatic measurements, and simultaneous operation at several frequencies on separate ranges. The systems were designed to meet a wide variety of measurement requirements. Author

N64-24747 Boeing Co., Wichita, Kan.
A RADAR BACKSCATTER RANGE FOR MEASUREMENT OF LARGE MODELS
Wesley G. Louie and Charles W. Matthis, Jr. *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 303–305 (See N64-24712 17-08)

An outdoor, monostatic, continuous-wave oblique-type radar cross section range is being used for the measurement of large-scale aircraft models. This paper give the range description, capability, and equipment, and the measurement methods. G.D.B.

N64-24750 Rome Air Development Center, Griffiss AFB, N.Y.
RADAR TARGET SCATTER (RATSCAT) SITE
Donald Montana *In its* Symp. on Radar Reflectivity Meas. Apr. 1964 p 321–329 (See N64-24712 17-08)

This report describes the design and operation of a Radar Target Scatter Site (RATSCAT) radar cross-section measurement range presently being implemented at Holloman Air Force Base, New Mexico. Briefly described are RATSCAT site characteristics and capabilities, including a description of a ground plane range, the frequency coverage, data recording, calibration, and target size. Measurement rate is treated only briefly. The initial capability is compared with the advanced capability buildup in terms of target size, minimum cross section, and measurement accuracy. Author

N64-24754 Naval Missile Center, Point Mugu, Calif.
U.S. NAVAL MISSILE CENTER RADAR REFLECTIVITY MEASUREMENT FACILITIES AND TECHNIQUES
John K. Rozendal *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 354–358 (See N64-24712 17-08)

The radar reflectivity measurement facilities used at the U.S. Naval Missile Center include a microwave anechoic chamber, an optical simulation facility, and AN/FPS-16 instrumentation radars. A brief description of each of these facilities is included. Techniques used in the anechoic chamber are presently continuous-wave measurement methods. Optical techniques are utilized in the optical simulation facility to obtain mean radar cross section data. Conventional radar techniques are employed in the AN/FPS-16 radar installation that are instrumented to obtain radar cross section data. Author

N64-24755 Conductron Corp., Ann Arbor, Mich.
CONDUCTRON CORPORATION'S RADAR CROSS SECTION RANGE
A. W. Wren, Jr. *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 359–362 (See N64-24712 17-08)

Although the facility was originally developed for the measurement of low cross-section full-scale vehicles, measurement activity now extends from the measurement of small models and decoys in an anechoic chamber to bistatic measurements of the Echo II passive satellite. In all cases, CW measurement systems are used. There are two separate and distinct measurement areas. Measurements are made on full-scale vehicles weighing up to 2,500 lb on an outdoor range facility. Small models are measured in the indoor anechoic chamber. Author

N64-24756 General Electric Co., Philadelphia, Pa. Missiles and Space Div.
DESCRIPTION AND OPERATION CHARACTERISTICS OF A SHORT-PULSE, OBLIQUE RADAR CROSS-SECTION RANGE
Malcolm Yaffe *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 363–372 (See N64-24712 17-08)

The short-pulse, oblique radar cross-section range can measure large, heavy targets with low values of radar cross section accurately and rapidly—and safely in inclement weather. Measurements can now be made at UHF, L, and C bands, and soon will be possible through K_A band at all linear polarizations. Author

N64-24933 Polytechnic Inst. of Brooklyn, Freeport, N.Y.
USE OF A SUPERSONIC COMPRESSOR FOR A HIGH ENTHALPY TEST FACILITY
Robert J. Cresci and Marian Visich, Jr. Wright-Patterson AFB, Ohio, ARL, Apr. 1964 34 p refs
(Contract AF 33(657)-8286)
(ARL-64-64; AD-441228)

The design criteria and estimated performance of a multistage compressor operating from either of two typical high-temperature sources are presented herein. The first is a pebble bed heater capable of achieving stagnation conditions of approximately 3,000° R and 200 atmospheres. Complete temperature simulation can be obtained, with this air supply, for a flight Mach number of 6.0 at an altitude of 50,000 ft. If a compressor tip velocity of 2,000 fps is assumed (tip speeds close to this value have been achieved in practice), the conditions for total simulation at the exit of the first stage correspond to a Mach number of 9.0 and an altitude of 58,000 ft. The addition of subsequent stages increases the Mach number capability of the system at a relatively small increase in

flight altitude. The second source of high-temperature air considered is an arc heater. Large improvements in the performance of this heater are also obtained by the addition of a multiple stage compressor. Author

N64-24961 Swedish State Shipbuilding Experimental Tank, Goteborg
CURRENT RESEARCH WORK OF THE SWEDISH STATE SHIPBUILDING EXPERIMENTAL TANK General Report No. 8
Hans Lindgren 1964 43 p refs
(SSPA-AR-8)

Current work is discussed and research results are given regarding resistance, propulsion, cavitation, seakeeping, maneuverability, and ship trial and service analysis. Author

N64-25097 Federal Aviation Agency, Atlantic City, N.J. Experimentation Div.
RECOMMENDATIONS FOR EQUIPMENT CONFIGURATION STANDARDS FOR TOWER CABS Final Report
J. Roy Bradley and Richard K. Ohman Apr. 1964 36 p refs
(RD-64-64)

This report contains the results of a series of air traffic control exercises that were conducted to determine a limited number of equipment arrangements that can be used as agency standards for control towers of four different workload levels. The test facility consisted of a pentagonal tower cab mounted on top of a 110-ft structure. Inside the cab, a mockup was constructed of specially designed consoles and console instrument turrets that could be moved from place to place. The mockup served as a simulator for testing the efficacy of various equipment configurations. Recommendations are presented for each workload level. Author

N64-25174 National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.
THE EFFECTS OF HIGH PRESSURE ON THE FLOW IN THE REFLECTED SHOCK TUNNEL
L. Davies, L. Pennelegion, P. Gough, and K. Dolman 20 Sep. 1963 26 p refs
(NPL-AERO-1072; ARC-25071)

To increase the overall pressure level of shock tunnels owing to the emphasis and need, especially in the U.S., it is necessary to have flight simulation of reentry and hypersonic cruise conditions. Helium and hydrogen as driver gases are to be used at pressures up to 20,000 lb/in.^{2} in facilities currently under construction. Subject to overcoming the mechanical engineering difficulties associated with high-pressure containment, it was generally assumed that the capability of the shock tunnel would be increased proportionately in pressure and density by the ratio of the change in driver pressure. Experiments using helium and nitrogen at steady driving pressures up to 10,000 psi have supported theoretical considerations of the bulk properties of gases at high pressure, and shown that the available testing time is markedly reduced. Working section conditions of the shock tunnel are normally defined by the ratio of pressures upstream and downstream of the hypersonic nozzle. The influence of compressibility in the reflected shock region on the shocked-gas parameters was studied, and although the magnitude of reflected shock pressure is close to ideal, the density and temperature may differ significantly from the ideal value. It is clear that the measurement of stagnation pressure alone will not adequately define the flow parameters in the working section. Author

N64-25188* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLOW EVALUATION IN AN ARC-HEATED HYPERSONIC WIND TUNNEL
Roger B. Stewart and John E. Grimaud Washington, NASA, Jul. 1964 32 p refs
(NASA-TN-D-2344) OTS: $0.75

An investigation was conducted to determine the thermodynamic and chemical state of initially dissociated air during expansion in a hypersonic nozzle. Results of tests in conical nozzles having total divergence angles of 10° and 16° indicated an equilibrium expansion for stagnation temperatures on the order of 3,600° K and stagnation pressures of 12 and 20 atm. (A computer program predicted that significant departure from equilibrium would occur at these stagnation conditions.) The method employed for defining the state of the gas was based on independent measurements at corresponding locations of wall static pressures and center-line pitot pressures. Good agreement was found between Mach numbers as determined from measured wall pressures and Mach numbers determined from measured pitot pressures. The measured pressure were used with calculated real-gas flow properties to obtain local values of Reynolds number, effective core size, density, velocity, and the oxygen dissociation fraction. Author

N64-25192 McGill U., Montreal (Canada) Mechanical Engineering Research Labs.
THE DESIGN OF A TWO-DIMENSIONAL BLOWING SLOT AND ITS APPLICATION TO A TURBULENT WALL JET IN STILL AIR
I. Gartshore and O. Hawaleshka Jun. 1964 49 p refs
(Grant G-9551-12)
(TN-64-5)

This note describes the design of a new two-dimensional blowing slot installed in a 17- × 30-in. wind tunnel, and its use to measure the downstream characteristics of a wall jet in still air. This slot replaces that described by Patel for the examination of self-preserving wall jets. Results of experiments to check downstream two-dimensionality of the jet from the slot show that mean velocities at equal levels across a 12-in. center lane were within ±1%. The total momentum thickness of both slot boundary layers was always less than 4% of the slot width, for slot widths from 0.1 to 0.5 in. Measurements of the development of the downstream wall jet in still air were made and compared with previous measurements. The effect of slot lip thickness in reducing the downstream momentum was briefly investigated. Author

N64-25214 Melpar, Inc., Falls Church, Va.
SIMULATION OF HELICOPTER AND V/STOL AIRCRAFT. VOLUME I: HELICOPTER ANALYSIS REPORT
James R. Toler, Walter Mc Intyre, and Merlin P. Coffee Sep. 1963 325 p refs
(Contract N61339-1205)
(NAVTRADEVCEN-1205-1; AD-601022)

Aerodynamic equations are developed through a modified blade element approach, although other alternative techniques are considered. The equations are not constrained to a given or any number of given flight conditions but are valid for the entire flight regime including hover, transition, autorotation, the effects of varying altitude, ground effects, and blade aeroelasticity in twist. The dynamic derivation develops a set of unabridged and simplified equations of translational and angular rates specifically for a tandem-rotor helicopter. The dynamic and aerodynamic effects on the helicopter rotor are combined to produce equations to describe blade acceleration, velocity, and position, while flapping, at chosen points during a rotation. The equations developed and presented within the

report have been used to create a complete mathematical model of both a single-rotor and a tandem-rotor helicopter and programed on a 7090 digital computer over a wide range of flight conditions; the results were verified. Author

N64-25367 McGill U., Montreal (Canada) Mechanical Engineering Research Labs.
DESIGN AND CONSTRUCTION OF A HYPERSONIC SHOCK TUNNEL
N. F. Amin Apr. 1964 98 p refs
(Grant DRB-G-9550-06)
(Rept.-64-3)

The shock tunnel has been designed to produce air at minimum stagnation temperature and pressure of 4,200° R and 2,300 psi, respectively, and maximum stagnation temperature and pressure of 14,300° R and 20,000 psi, respectively, at the nozzle entrance. Air at these stagnation conditions, when expanded in the test section, will completely simulate free flight conditions (i.e., pressure, temperature, unit Reynold's number, Mach number, etc.) in and around a hypersonic ramjet flying over an altitude range of 90,000 ft to 250,000 ft and a corresponding Mach number range of 7.5 to 18.5. Preliminary tests have been successful and have indicated that the recoil mechanism is capable of absorbing the shock forces; the gun barrels, joined end to end, produce a well-aligned, rigid, and strong driven section; and the actual recoil stroke will probably be considerably less than the initially assumed value of 4 in. Author

N64-25390 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A LABORATORY FOR TESTING OF ENGINES, AND THEIR UNITS AND COMPONENTS
In its Testing Air-Breathing Engines, 28 Jan. 1964 p 139–171
(See N64-25386 17-27)

Engine testing laboratories in the Soviet Union are described in terms of air systems, exhaust systems, fuel systems, auxiliary systems, high-altitude engine testing, testing of bladed equipment, testing of combustion chambers, and auxiliary engine element testing. G.D.B.

N64-25391 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TESTING STATIONS
In its Testing Air-Breathing Engines, 28 Jan. 1964 p 172–234
(See N64-25386 17-27)

Described in this paper are testing stations employed for testing aviation engines under ground conditions. The stations represent a complex of built-up structures equipped with testing cabins in which the engines to be tested are installed; with control rooms from which the engines are controlled and the functioning of the engines is monitored; and with production buildings to house the various power-supply systems for the testing installations. Each station has auxiliary structures. G.D.B.

N64-25392 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE TECHNOLOGY OF SERIES TESTING OF AIR-REACTION ENGINES
In its Testing Air-Breathing Engines, 28 Jan. 1964 p 235–258 (See N64-25386 17-27)

The technological procedure of testing an engine is divided and described as the readying of the engine for the test, the mounting of the engine on the test stand, the actual tests, the dismantling of the engine from the stand, and the finishing operations on the engine. This series of events is described as it is practiced in the Soviet Union. G.D.B.

N64-25427 General Dynamics/Fort Worth, Tex.
HYPERTHERMAL RESEARCH FACILITY Progress Report No. 3
J. E. Burroughs and R. A. Stevens *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 917–923 (See N64-25408 17-01)

The 1.8 mw arc-heated Hyperthermal Research Facility (HRF) currently in operation is basically a high enthalpy (18,000 Btu/lb) free jet, supersonic–hypersonic wind tunnel that uses gases, such as air, nitrogen, and argon, as the primary working fluid. The gas is heated in a magnetically stabilized electric arc plasma generator, expanded through an axisymmetric nozzle into a free-jet test section and exhausted through a diffuser, a cooling section, and a steam jet ejector system. Water-cooled copper electrodes are used in the plasma generator to reduce the contamination in the test stream. The HRF is presently in the checkout and calibration phase. The primary function of the HRF is ablation testing and the simulation of reentry thermal environments. I.v.L.

N64-25538 National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)
SOME EXPERIMENTAL INVESTIGATIONS ON RUNWAY WAVINESS
F. J. Plantema and J. Buhrman [1962] 12 p refs
(Sponsored By AGARD)
(MP-218)

A review is given of the work concerned with surface waviness of runways and taxi tracks. The collection of statistical data and the advantages and disadvantages of various forms of presentation of these data are discussed. Runway roughness criteria are dealt with very briefly. After a discussion of the shortcomings of existing systems and methods for measuring the range of wavelengths from 4 ft to 200 ft, the design of a slope measuring system is explained in some detail. A description of a provisional realization of this system is given, and the results of comparative measurements with the provisional system and with precision level-and-rod apparatus are presented. It is concluded that the system shows favorable characteristics as a rapid and simple measuring system. Author

N64-25552 Federal Aviation Agency, Atlantic City, N.J.
INVESTIGATION OF ADVANCED SEQUENCING AND CONTROL CONCEPTS IN AN AUTOMATED TERMINAL ENVIRONMENT VOLUME II: USE OF THE COMPUTER-DRIVEN-SIMULATION-ENVIRONMENT Final Memorandum Report
R. S. Pardee, D. Scheffler, F. Holland, E. A. Robin (TRW Computers Co.), A. G. Halverson et al Apr. 1963 67 p refs

The information presented consists of the following: (1) a brief description of the Computer Driven Simulation Environment (CDSE) as it was constituted during the previously mentioned simulation study; (2) considerations in programing the CDSE; (3) program checkout aids that were used to expedite the completion of the real-time simulation programs; (4) the operational procedures used in conducting the real-time simulation; (5) conclusions regarding the programing and use of the CDSE; and (6) major recommendations. Author

N64-25773* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HYPERVELOCITY SHOCK TUBE
Daniel J. Collins, Floyd R. Livingston, Terry L. Babineaux, and Norman R. Morgan 15 Jun. 1964 20 p refs
(Contract NAS7-100)
(NASA-CR-56969; JPL-TR-32-620) OTS: $1.60 ph

The design and performance of the hypervelocity 6-in. shock tube are described. The facility is capable of simulating planetary entry velocities of 45,000 fps. Shock velocities of 32,000 fps into 0.250-mm Hg of air were achieved in the 6-in. tube, with a useful test time of 12μsec. Investigations of convective heat transfer and radiant heat transfer were completed. Author

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-24249 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
POWER EQUIPMENT MANUFACTURE Selected Articles
18 Oct. 1962 18 p refs Transl. into ENGLISH of Two Articles from Energomashinostr., no. 10, 1961 p 23–26, 48
(FTD-TT-62-1023/1+2+4; AD-290829)

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1. INVESTIGATION OF AIR-STREAM COOLING OF GAS TURBINE DISKS L. A. Dorfman and Yu. S. Osherov p 1–13 refs (See N64-24250 17-11)
2. EXPERIMENTAL HIGH-TEMPERATURE GAS TURBINES OGT-850 OF THE CENTRAL SCIENTIFIC RESEARCH INSTITUTE FOR BOILERS AND TURBINES I. M. Yefimov p 14–15 refs (See N64-24251 17-11)

N64-24250 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF AIR-STREAM COOLING OF GAS TURBINE DISKS
L. A. Dorfman and Yu. S. Osherov *In its* Power Equipment Manuf. 18 Oct. 1962 p 1–13 refs Presented at the XIV Sci.-Tech. Session of the Comm. on Gas Turbines, Acad. of Sci. (USSR), 29 Mar. 1961 (See N64-24249 17-11)

Results of temperature measurements of the metal of gas turbine disks cooled by airstreams are presented. Interpolation formulas for approximate determination of disk temperature are found. Author

N64-24251 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXPERIMENTAL HIGH-TEMPERATURE GAS TURBINES OGT-850 OF THE CENTRAL SCIENTIFIC RESEARCH INSTITUTE FOR BOILERS AND TURBINES
I. M. Yefimov *In its* Power Equipment Manuf. 18 Oct. 1962 p 14–15 (See N64-24249 17-11)

The experimental gas turbine OGT-850 is intended for use in investigating air-cooling systems for the rotors and cases of gas turbines. The turbine is calibrated for a starting gas temperature of 850° C and develops 1,000 kw of power. The air for the combustion and for the cooling is obtained from an outside source; the power is reduced by a hydraulic brake having three chambers. By filling the chambers with water to various heights, the turbine can be operated over a wide range of revolutions at a constant power, or operated at a constant speed at variable power. P.V.E.

N64-24574 Radio Corp. of America, Moorestown, N.J. Missile and Surface Radar Div.
PRESSURE GRADIENT EFFECTS ON NONEQUILIBRIUM LAMINAR AND TURBULENT FAR WAKES
N. Ness and J. B. Fanucci Mar. 1964 76 p refs
(Contract DA-36-034-ORD-3144Z; ARPA Order 51; Proj. Defender)
(DAMP-TM-63-13; AD-435468)

Pressure gradient effects on nonequilibrium far wake flow properties are evaluated. Transition to turbulence is included in the analysis. Calculations were performed for two cases; in one case the pressure is constant at its ambient value, whereas in the second case the pressure distribution (assumed to be that given by blast wave theory) decreases rapidly, in the downstream direction to its ambient value. The results show that the pressure gradient has a significant effect on the wake thickness and electron number density, but only a small effect on fluid velocity and temperature. Specifically, pressure gradient decreases the wake thickness and reduces the electron number density. When these two effects are combined, a pressure gradient produces a much smaller volume (and number) of ionized particles than does the constant pressure case. Author

N64-24798 Aerospace Corp., San Bernardino, Calif.
NONEQUILIBRIUM SODIUM IONIZATION IN LAMINAR BOUNDARY LAYERS
John J. Kane 14 Apr. 1964 30 p refs
(Contract AF 04(695)-Z69)
(BSD-TDR-64-50; TDR-Z69(S4810-22)-2; AD-601326)

The injection of sodium as a trace contaminant into a laminar boundary layer is considered. Three ionizing reactions are studied, and it is found that the ionization by collision with atomic oxygen is the most significant. The peak electron concentration is determined as a function of the scaling parameter, Px/U_e. Comparisons are made with the predicted clean air variations with the same parameter. Stream tube predictions (neglecting diffusion) are also made and compared with the more exact results. The relative ionization of clean air and sodium is assessed as a function of altitude and amount of injection material. Bortner's rates are used for the nonequilibrium sodium ionization. Author

N64-24891 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)
ON THE THEORY OF CLASSICAL FLUIDS — IV
Loup Verlet Jun. 1964 15 p refs
(Sponsored in Part by the Air Force)
(Th.-55116)

Percus' method was used to derive new integral equations that should correct the Percus–Yevick and the hypernetted chain equations at high density. A method is described that can be used to solve the higher order equations and to calculate the correction term to the integral equation for the two-body correlation functions. The correction terms that have been considered give an exact fourth virial coefficient. The fifth virial coefficient is calculated for the case of purely repulsive potentials. R.T.K.

N64-24913 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.

PREDICTION OF VACUUM LEVELS FOR UNPRESSURIZED COMPARTMENTS DURING A LEM MISSION

Richard A. Oman and Arthur Miller Mar. 1964 16 p refs

(RN-178L)

A mathematical analysis is presented for the prediction of vacuum pressure levels in several areas of the Lunar Excursion Module (LEM) vehicle. The differential equation for free molecular venting is developed, and the criterion for the establishment of free molecular flow are set down in order to solve the free molecule equation. J.L.D.

N64-24923 National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.

HIGH PRESSURE REAL GAS DRIVERS AND TAILORING IN SHOCK TUNNELS

L. Davies 6 Jan. 1964 18 p refs

(NPL-AERO-1088; ARC-25486; HYP-384)

The diaphragm pressure ratio required to produce a particular shock Mach number in a shock-tunnel gas depends not only on the driver gas used but also on absolute pressure of the driver gas. The effects of variation from ideal gas conditions are considered for both helium and hydrogen as driver gases, and a tailored interface technique is used to determine the Mach number at which the pressure remains constant and equal to p_5 until the arrival of the head of the expansion wave from the high-pressure section. It is shown that the variation of this tailoring Mach number, which varies from facility to facility, can be predicted from the effects of nonideal driver pressures on the expanded driver-gas flow. M.P.G.

N64-24937 Massachusetts Inst. of Tech., Cambridge

MEASUREMENT AND CHARACTERIZATION OF TURBULENT MIXING Final Report, 18 Dec. 1957–15 Dec. 1963

G. C. Williams May 1964 6 p refs

(Contract DA-19-020-ORD-4549; Grants DA-ORD-31-124-61-G55; DA-ARO(D)-13-124-G23J)

(AD-441220; AROD-2013-8)

A scattered light technique was developed that permits the direct measurement of the local values of concentration fluctuation in the interior of the mixing region of two gaseous streams without the use of a fluid-sampling probe. Quantitative relationships were derived for evaluating the performance of the scattered-light technique in resolving the spectrum and intensity of turbulence in terms of the dimensions of the observed volume and the size of the smoke particles, which scatter the light. This new technique was used to characterize the intensity, scale, and spectral distribution of the concentration fluctuations in the mixing of a smoke-marked free jet with quiescent air. The new technique was also used to study a sound jet with confining concentric walls and with a means for controlled coaxial introduction of a secondary airstream. A preliminary design was made of a device in which magnesium ribbons can be burned at a controlled rate to produce MgO smoke of nearly uniform 1μ size and at a steady concentration. I.v.L.

N64-24955 National Physical Lab., Teddington (Gt. Brit.) Aerodynamics Div.

EXPERIMENTS ON TWO-DIMENSIONAL BASE FLOW AT SUBSONIC AND TRANSONIC SPEEDS

J. F. Nash, V. G. Quincey, and J. Callinan 21 Jan. 1963 87 p refs

(NPL-AERO-1070; ARC-25070)

A report is presented of a series of experiments aimed at an investigation of the fundamental mechanisms of the flow behind an isolated blunt-trailing-edge section, and a rearward-facing step, at subsonic and transonic speeds. Pressure measurements and flow photography formed the principal research tools, but in connection with the tests on the isolated section, an extensive wake exploration and a study of the vortex shedding process were carried out. Tests were also made of simple devices that interfere with the formation of the vortex street. These tests are useful both from a basic research aspect and insofar as they indicate possible methods of reducing base drag. A careful study is made of the events associated with the transition, at transonic speeds, from the subsonic vortex-street regime to the supersonic steady-flow regime. Author

N64-24983 General Applied Science Labs., Inc., Westbury, N.Y.

GENERALIZED ONE-DIMENSIONAL CHEMICALLY REACTING FLOWS WITH MOLECULAR VIBRATIONAL RELAXATION

Bruce D. Gavril 29 Jan. 1964 211 p refs Prepared under Subcontract for MIT

(Contract AF 19(628)-500; ARPA Order-13; Proj. Defender)

(TR-426; AD-435623)

This work is concerned with the problem of the analysis of generalized, one-dimensional, chemically reacting flows with molecular vibrational relaxation and its solution by means of high-speed digital computers. The analysis and programs incorporate a number of features, among which are the following: optional relaxation of the vibrational energy of diatomic species, coupling of vibrational energy to rate of dissociation, provision for more elaborate vibrational relaxation models, a wide choice of chemical reactions and species, provision for prescribing either the pressure distribution or the area variation (i.e., duct flow) with wall friction and heat transfer, provision for oblique shocks, flexibility in the treatment of electronic energy, and a number of other features. Author

N64-24992 Princeton U., N.J.

THE EFFECTS OF PRESSURE GRADIENTS ON A TURBULENT FLOW NEAR A SMOOTH WALL

G. L. Mellor Jan. 1964 39 p refs

(Contract Nonr-(1858)38)

(FLD-14; AD-601277)

A dimensional argument is presented leading to a functional form for the effective viscosity, which embraces the hypothesis of a previous paper (Mellor and Gibson, 1963) in the overlap and outer regions of a turbulent boundary layer. The new argument also suggests a way of determining the effective viscosity in the viscous sublayer when the flow is subjected to main stream pressure gradients. This information is used to calculate velocity profiles near the wall and, in particular, to demonstrate deviations from the logarithmic law of the wall when the wall-layer parameter is excessively large. Author

N64-24993 Princeton U., N.J.

EQUILIBRIUM TURBULENT BOUNDARY LAYERS

G. L. Mellor and D. M. Gibson Nov. 1963 47 p refs

(Contract Nonr-1858(38))

(FLD-13; supersedes FLD-5; AD-601276)

A particular form for an effective or eddy viscosity is hypothesized and considered in conjunction with the boundary-layer equations for cases where the pressure gradient parameter, $\beta = \delta^*(\mathrm{op}/\mathrm{dx})\tau_0$, is held constant. Precise solutions are obtained for accelerating and decelerating flows in the range, $-0.5 \leq \beta \leq \infty$; the solutions span the complete boundary-layer

profile with the exception of the small viscous sublayer region. Comparison of the calculated velocity profiles with zero pressure gradient data and Clauser's and Stratford's decelerating flow data is excellent. For large values of β the influence of the pressure gradient dominates the influence of the wall shear stress. Author

N64-25014* Pennsylvania State U., University Park
CAVITATION HYSTERESIS
Allen L. Treaster (M.S. Thesis) Jun. 1964 200 p refs
(Grant NsG-85-60; Contract NOrd-16597)
(AD-436602)

Cavitation hysteresis was investigated. Results indicate the following: (1) The model of cavitation hysteresis that is based on the concept of random sampling of the free-stream nuclei seems to be the most consistent with the majority of the results. (2) The majority of the tests appear to indicate that the free-stream nuclei may be the primary source of cavitation nuclei. (3) The cavitation delay time increases with increasing cavitation number and generally increases with decreasing air content. (4) The cavitation delay time decreases with increasing test section velocity, with the exception of the tests conducted at high air content at a speed of 40 ft/sec. (5) No hysteresis effects were observed on the hydrofoil tested. (6) It appears that the cavitation delay time is more dependent upon the exposure pressure than upon the exposure time. Appendices cover the inspection of the NASA tunnel cavitation models; calibration of the NASA ultrahigh speed cavitation tunnel; particle content of the tunnel water; growth of a bubble by air diffusion including and neglecting the velocity transport term; minimum bubble radius; unstable bubble radius; the calculation of the cavitation number and sample calculations; and flow rate through the centrifugal pump bearing. I.v.L.

N64-25105 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
MODELS OF GAS FLOWS WITH CHEMICAL AND RADIATIVE EFFECTS
F. K. Moore *In* Am. Math. Soc. Lecture Notes Prepared in Connection with the Summer Seminar on Space Math., Pt. III 1963 p 467-549 refs (See N64-25102 17-29) OTS: $17.00 ph

Considered are flows with chemical activity in which radiative effects are of significance—in particular, those dealing with problems of reentry and propulsion. A wide variety of assumptions and of physical and mathematical models, useful in the analysis of hypersonic flows of a real dissociating gas are discussed. R.T.K.

N64-25184 McGill U., Montreal (Canada) Mechanical Engineering Research Labs.
A DIGITAL COMPUTER PROGRAM FOR THE CALCULATION OF COMBUSTION DRIVEN SHOCK TUNNEL PERFORMANCE
N. F. Amin and T. K. Morton Apr. 1964 75 p refs
(Grant DRB G-9550-06)
(TN-64-1)

A digital computer program was written in FORTRAN to calculate the performance of a combustion-driven shock tunnel. Stoichiometric hydrogen and oxygen, along with from 50% to 87% helium are used in the driven section at initial precombustion pressures from 100 to 2,000 psi. The driven tube is assumed to contain air at atmospheric pressure, and by means of curve fits for air properties, equilibrium real gas effects are taken into account. G.D.B.

N64-25207 California U., Los Angeles Aerosonics Lab.
AN AEROSONICS BIBLIOGRAPHY Supplement No. 1
Alan Powell and T. J. B. Smith Apr. 1964 23 p refs
(Contract Nonr-233(62))
(Rept.-64-20; AD-600455)

This supplementary bibliography is to be used in conjunction with the University of California, Los Angeles, Engineering Report No. 63-51; it contains available references to the open literature on aerosonics up to March 1964. In addition, the scope of the bibliography has been enlarged to include references to the fluid dynamics of supersonic jet flows. I.v.L.

N64-25242 Brown U., Providence, R.I. Div. of Applied Mathematics
ONSET OF CONVECTION IN A RAPIDLY ROTATING FLUID SPHERE
F. E. Bisshopp and P. P. Niiler Jun. 1964 28 p refs
(Contract Nonr-562(07))
(TR-57 Rept.-562(07)/57; AD-601996)

The nature of the constraint imposed by rapid rotation on convective motions at their onset in a plane liquid layer can be found from an exact solution of the problem. The physical insight derived from the simpler problem is used to formulate an asymptotic approximation to the equations governing the analogous problem in a sphere. The solutions obtained for the asymptotic equations provide an asymptotic approximation of the dependence of the critical Rayleigh number for the onset of convection on the Taylor number. Author

N64-25246 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.
ON THE STRUCTURE OF A RADIATION-RESISTED SHOCK IN A SIMPLE DISSOCIATING GAS
Inge Ryhming 15 May 1964 64 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-47; TDR-269(4230-20)-7; AD-602240)

The structure of a radiation-resisted hypersonic shock in a simple dissociating gas is studied by using the quasi-equilibrium theory in obtaining the radiation field. The continuous absorption coefficient of the molecules is evaluated from a wave mechanical model developed previously. The basic equations of the problem reduce to a coupled set of integral and differential equations for the velocity and the degree of dissociation. Properties of the structure are found from a study of these equations around the end points in a phase diagram. For quantitative predictions, actual data for the reaction rate constant and the absorption continuum for oxygen are used. A net amount of radiant energy is transferred from the region immediately behind the shock to the region upstream and further downstream of the shock. This result is a consequence of treating the gas as nongrey. If the gas is taken to be grey, another flow configuration is found. The effect exerted by the radiation on the flow is small for the particular shocks investigated—shock Mach number less than 20 in oxygen and free-stream pressure ranging from 1 to 10 mm Hg). Author

N64-25248 Aerospace Corp., El Segundo, Calif. Applied Mechanics Div.
EXTENSION OF BELOTSERKOVSKII'S DIRECT METHOD TO REACTING GAS IN THERMODYNAMIC EQUILIBRIUM
S. T. Chu 18 May 1964 57 p refs
(Contract AF 04(695)-269)
(TDR-269(4560-10)-3; SSD-TDR-64-81; AD-601963)

Belotserkovskii's integral method of analyzing the flow field behind the curved shock about a blunt body is extended to cover cases of (1) arbitrary blunt body in two-dimensional or

axisymmetric flow, and (2) real gas in thermodynamic equilibrium. Detailed derivation is given for the simple case of linear interpolation. Extension to third-order interpolation is also treated with a different but simpler scheme in that the shock layer will not be subdivided into strips as in the original work of Belotserkovskii. The resulting differential system for the high-order analysis consists of only three total differential equations, two of which are of the second order. Numerical results are presented on the basis of the first-order theory for flow field about spherical and ellipsoidal noses. Shock detachment distances obtained for the spherical nose are consistent with those obtained by using the Gravalos method. Significant differences exist between the results of real gas and those of perfect gas analyses. Author

N64-25253 Harry Diamond Labs., Washington, D.C.
PROCEEDINGS OF THE FLUID AMPLIFICATION SYMPOSIUM, VOLUME I
May 1964 394 p refs Symp. Held at HDL; Washington, D.C., 26–28 May 1964
(AD-602000)

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20. A HIGH GAIN PROPORTIONAL FLUID STATE FLOW AMPLIFIER M. B. Zisfein and H. A. Curtiss (Giannini Controls Corp.) p 375–393 refs (See N64-26273 17-11)

N64-25254 Houston U., Tex. Cullen College of Engineering
THE VISCOUS DISSIPATION OF ENERGY IN FREE TURBULENT FLOWS OCCURRING IN FLUID AMPLIFIER OPERATION
J. E. Cox *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 5–17 refs (See N64-25253 17-11)

A discussion of the solutions of the equations of motion and the energy equations is presented for the cases of free turbulent flows occurring in fluid amplifier operation. The effect of turbulent viscosity on these two equations is discussed. To determine the effects of the viscosity on the energy equation, the mechanism of the viscous dissipation of energy must be investigated. Evaluating the dissipation function independently provides expressions for the distribution of the viscous dissipation of energy. To illustrate the evaluation techniques involved, the simple case of the jet boundary is considered in detail. Author

N64-25255 Pennsylvania State U., University Park
SOME ASPECTS OF CURVED TURBULENT MIXING IMPORTANT IN FLUID AMPLIFIERS AND FLUID LOGIC DEVICES
D. P. Margolis *In* HDL Proc. of the Fluid Amplification Symp., Vol. I May 1964 p 19–38 refs (See N64-25253 17-11)

In a curved turbulent mixing layer, the flow is dynamically either stable or unstable, depending on whether the radial gradient of angular momentum is positive or negative. In the unstable case, mass entrainment is greater than for either the stable case or a straight mixing layer. The rate of dissipation of turbulent energy is an order of magnitude less in the unstable case than in the stable case. Based on present results, a fairly good prediction of the mean velocity profiles is possible. Author

N64-25256 Syracuse U., N.Y. L. C. Smith Coll. of Eng.
INVESTIGATIONS OF INTERACTING UNDEREXPANDING JET FLOWS
William J. Sheeran and Darshan S. Dosanjh *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 39–61 refs (See N64-25253 17-11)
(Grant NSF-GP-839)

Experiments were conducted to study the interaction of transversely impinging, two-dimensional, underexpanded jet flows. The recovery stagnation pressure distribution and shock structure of the impinging jet flow field was investigated, using a high underexpanded power jet interacting with various low

pressure control jet flows. Also, a method for determining the approximate Mach number distribution along the flow centerline is discussed. D.S.G.

N64-25257 United Aircraft Corp., East Hartford, Conn. Research Labs.
SPREADING RATES OF COMPRESSIBLE TWO-DIMENSIONAL REATTACHING JETS
Thomas J. Mueller and Robert E. Olson *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 63–79 refs (See N64-25253 17-11)
(Contract DA-49-186-AMC-66(X))

The results of an investigation of the spreading rates of compressible two-dimensional reattaching jets and tangential wall jets are reported. For the reattaching jets, four initial jet Mach numbers—two subsonic and two supersonic—were investigated for each of two setback distances and two angles of the adjacent wall. Three initial jet Mach numbers—two subsonic and one supersonic—were employed for the tangential wall jet. These data are presented along with previously reported free jet data. Velocity profiles were obtained from a combination of pitot-pressure surveys across the jet and static pressure measurements along the wall and jet centerline by assuming a constant total temperature throughout the jet. Values of the spread parameter were obtained for each type of jet flow by fitting the nondimensional velocity profiles to the gaussian profile and the error function profile in the region where the velocity ratio is 0.5. Using these values of the spread parameter, a comparison was made of typical experimental nondimensional velocity profiles with the theoretical error function and gaussian velocity profiles. The significance of this comparison and the spreading rates obtained are discussed in relation to the velocity profile development characteristics of jet flows in fluid amplifiers. Author

N64-25258 United Aircraft Corp., East Hartford, Conn. Research Lab.
THE INTERACTION OF OBLIQUE SHOCKS AND EXPANSION WAVES WITH A JET BOUNDARY MIXING ZONE
Robert E. Olson and David P. Miller *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 81–107 refs (See N64-25253 17-11)
(Contract DA-49-186-ORD-912)

Studies of the interaction of oblique shocks and expansion waves with a jet boundary mixing zone were conducted, and analytical procedures are presented for computing the location and strength of the reflected waves associated with such interactions. The procedures involve a graphic stepwise calculation with the mixing zone divided into a finite number of constant Mach number regions. Results obtained from the analytical procedures for upstream Mach 2.0 are presented; they were in good agreement with experimental results. Also presented is an illustration of the applicability of the analytical procedures described to the prediction of pitot pressure profiles at various stations in a representative fluid amplifier. Author

N64-25259 Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.
SEPARATED FLOW IN CURVED CHANNELS
H. A. Curtiss, O. G. Feil, and D. J. Liquornik *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 109 (See N64-25253 17-11)

This report presents some results of a fundamental experimental study of separating curved channel flow both with and without secondary injection. The experimental studies, using air as the test medium, included tests of different aspect ratio elbows and a series of elbow curvatures. G.D.B.

N64-25260 Minneapolis-Honeywell Regulator Co., St. Petersburg, Fla. Research Lab.
JET INTERACTION NOISE
F. A. Moynihan *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 111–122 refs (See N64-25253 17-11)

Experience with proportional fluid amplifiers has shown that noise in the form of pressure fluctuations is generated within the device even after minimizing and/or eliminating the obvious noise sources, such as roughness, fluid impurities and flow separation conditions caused by strong positive static pressure gradients. An additional possible noise source, the jet interaction process of the power and control streams, was investigated by measuring the velocity fluctuations in the combined jets, using a hot-wire anemometer technique. Variables, for the experiments, include the geometry of the control and power streams as well as their relative pressure levels. The various shear layers, formed by the velocity discontinuities of the power and control streams, can be a significant noise source at upstream stations where a simple free jet would be relatively quiet. Author

N64-25261 Minneapolis-Honeywell Regulator Co., St. Petersburg, Fla. Research Lab.
DEFLECTION AND RELATIVE FLOW OF THREE INTERACTING JETS
F. A. Moynihan and R. J. Reilly *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 123–146 refs (See N64-25253)

Deflection of a power stream by means of interaction with unbalanced control streams, a phenomena basic to fluid amplifiers, was investigated experimentally. An expression for the combined stream deflection in terms of the acting forces is derived and verified by detailed measurements for two-dimensional incompressible flow. Presence of free boundaries and viscosity make it difficult to solve the jet deflection equation explicitly in terms of amplifier design parameters; so the relation of the interaction forces, as they affect the jet deflection, and the relative mass flows of the three streams were determined experimentally for a range of amplifier design variables. Momentum, static pressure, and centrifugal are significant in determining the deflection, and their relative importance is a function of the control stream average pressure for both small and large control ports. Average control stream mass flow, relative to the power stream mass flow, is essentially independent of jet deflection and is a function of the geometry and average control stream total pressure. Author

N64-25262 Harry Diamond Labs., Washington, D.C.
NOISE REDUCTION BY JET-EDGE AND RESONATOR COUPLING
Richard N. Gottron *In its* Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 147–156 refs (See N64-25253 17-11)

Noise of only relatively low amplitude is present in pneumatic amplifiers when the jet-edge frequency and the resonant-cavity frequency are approximately the same. When these two oscillations are out of tune, broadband audible noise is present. The amplitude of the noise in several successive velocity regions is shown by a series of photographs of a spectrum analyzer. Proportional amplifiers can be designed to effectively reduce the noise for chosen input parameters. Experiments indicate a reduction in pressure of the noise up to 80% for certain velocity ranges. The design criteria of splitter distance and cavity length are investigated and related to the design of proportional amplifiers. Author

N64-25263 Chrysler Corp., Detroit, Mich. Missile Div.
A HYDRODYNAMIC STUDY OF THE FREE-JET CLASS OF FLUID-JET AMPLIFIERS
Richard T. Cronin *In* HDL Proc. of The Fluid Amplification Symp., Vol. 1 May 1964 p 157–178 refs (See N64-25253 17-11)

A theoretical two-dimensional solution is presented for the free-jet class of fluid-jet amplifiers. As a preliminary investigation, it is assumed that both the primary and secondary streams of perfect fluid are guided by two-dimensional channels with straight and parallel walls. The deflection angle and the free streamline profile of the resulting jet are solved by using Kirchhoff's free streamline theory. The jet deflection angle was related in closed form to both channel flows, both channel widths, the included angle between the channels, and the jet flow and its speed. The amplifier geometrical configuration is completely specified when certain mapping equations, usually requiring numerical integration, yield the free streamline profile of the jet and the coordinates of both channel exits. Author

N64-25264 International Business Machines Corp., Zurich (Switzerland) Research Lab.
WALL REATTACHMENT DEVICE WITH PULSED CONTROL FLOW
H. R. Müller *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 179–215 refs (See N64-25253 17-11)

The flow gain characteristics of a monostable wall reattachment fluid amplifier show clearly that for high flow gain, a double-sided element is superior to a single-sided one. The effective angle Θ^* (angle between the deflected jet and the adjacent wall, shortly before switching) was determined for different aspect ratios and wall lengths, and is compared with the results of Bourque and Newman. At large wall lengths, the curve approaches the curve of Bourque et al, though their results were obtained with an element where the angle Θ^* was varied by changing the wall angle Θ; whereas in this experiment, the angle Θ was increased by the injection of control flow. The optimization of a bistable wall reattachment amplifier with respect to flow and pressure gain is reported. Most important are the wall offset and the control channel resistances R_c. The switching mechanism was observed by flow visualization, and an attempt is made to describe the switching mechanism by a simple analytical model. A comparison with measured response times is given. Response time measurements were also carried out with pulsed control flow. The results suggest that control flow has to be injected until the separation bubble has been filled to such an extent that the switching process becomes self-sustaining. With a control pulse duration time of 40 times the transport time τ_T, and a control supply pressure of 0.7 times the supply pressure, the jet could still be switched over. The control pulse duration time was 30% of the response time measured under normal conditions. Author

N64-25265 International Business Machines Corp., Zurich (Switzerland) Research Lab.
REMARKS ON THE LIMITATIONS OF PURE FLUID ELEMENTS
H. H. Glaettli, H. R. Müller, and R. H. Zingg *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 217–232 refs (See N64-25253 17-11)

Refinements of the limitation of pure fluid elements are discussed. Basic effects in connection with the aspect ratio (turbulent reattachment, laminar attachment) are also discussed; on the other hand, the influence of deviations from ideal geometries is demonstrated. These deviations comprise oblique walls and surface roughness factors that can no longer be neglected. Shown in a quantitative way is the width of the gap to be overcome by improved or new manufacturing techniques. Consequences of requirements such as given output pressure or given response time are demonstrated. A new figure of merit in connection with bandwidth considerations is proposed. This figure of merit is expected to be always smaller than one. It can be applied to elements with or without intrinsic positive or negative feedback. The effect of feedback, implicitly present in various pure fluid elements, on the response time when switching in a different direction occurs, is demonstrated by a film. Author

N64-25266 Massachusetts Inst. of Tech., Cambridge
ON THE STABILITY OF FLUID SYSTEMS
F. T. Brown *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 233–255 refs (See N64-25253 17-11)

Fluid systems, especially those containing proportional fluid amplifiers with no moving parts, often display little-understood bistable or cyclic instabilities. Two general criteria for small-disturbance stability are presented, with simple illustrations involving amplifiers, lines, and volumes. Application of the criteria to real systems is based on separate measurements of certain static and dynamic properties of the more complicated elements, and analysis of the separate properties of the other elements. Author

N64-25267 Bowles Engineering Corp., Silver Spring, Md.
LOW-PASS FILTERS FOR PNEUMATIC AMPLIFIERS
Ronald L. Humphrey and Francis M. Manion *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 257–278 ref (See N64-25253 17-11)

This paper presents some experimental results of tests performed on preliminary low-pass filter designs for pneumatic systems. The results indicate which of several methods of filtering seem most promising for application to pure fluid elements. Fluid systems, as their counterparts in electronics, are subject to noise problems. High-gain pressure amplifiers have acoustic noise problems by virtue of their design. To overcome these noise problems, it would be most desirable to eliminate the noise source, but in these elements the source of the noise is the geometrical configuration that gives high linear gain. Therefore, any effort to reduce noise would affect a desirable gain characteristic. It appears expedient to design filters to eliminate most of the undesirable noise while passing the amplifier signal. This is possible because a great deal of the objectionable noise occurs at a frequency far greater than the useful range of the amplifier. This paper deals with the experimentation of some low-pass filter designs. Author

N64-25269 Sperry Utah Co., Salt Lake City, Utah
BASIC REQUIREMENTS FOR AN ANALYTICAL APPROACH TO PURE FLUID CONTROL SYSTEMS
H. L. Fox and F. R. Goldschmied *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 293–320 refs (See N64-25253 17-11)

The first type of pure fluid amplifier is classified as a planar device, and some of the associated analytical and experimental problems are discussed. Another type of planar device based on the edge tone phenomena is described, and its operation is related to the same analytical and experimental problems. A new approach to pure fluid device design using axisymmetric geometry is discussed. The same set of problems are then related to the axisymmetric class of fluid devices. In particular, it is shown how the focused jet axisymmetric fluid device greatly simplifies analytical work. The work of Fromm and Harlow is displayed as a means of solving the Navier–Stokes equations

for the time-dependent two-dimensional viscous case. The impact of this new approach in device design and analytical techniques is discussed. Author

N64-25270 Harry Diamond Labs., Washington, D.C.
THE RESPONSE OF A BISTABLE FLUID AMPLIFIER TO A STEP INPUT
Silas Katz, E. T. Winston, and P. Hawes *In its* Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 321–339 refs (See N64-25253 17-11)

Switching times of two configurations of bistable fluid elements were measured at various power and control jet pressures. The units differed mainly in the ratio of control nozzle width—for element 1 this was 1.0 and for element 2 it was 0.67. The measured switching time for element 1 ranged from 13 to 44 μ5, and for element 2 from 100 to 150 μ5. The longer switching times for element 2 are believed to be due to the relatively smaller control orifice. The observed switching appears to be due to momentum forces. When these are not predominant, the switching times are expected to be appreciably longer. Author

N64-25271 Tulane U., New Orleans, La.
THE EFFECT OF GEOMETRIC CHANGES UPON THE SWITCHING POINT IN A MODEL BI-STABLE FLUID AMPLIFIER
Henry F. Hrubecky and Larry N. Pearce *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 341–350 refs (See N64-25253 17-11)
(Contract DA-01-009-AMC-33(Z))

This study was concerned with the effect of varying the principal geometric parameters upon the switching point in a model bistable fluid amplifier. A single model system was designed to give maximum geometric flexibility, which permitted a systematic evaluation of effect of geometry on amplifier operation. The parameters included the primary and control jet intersection angle, the setback, the position proximity of the control jet with respect to the primary jet, the width of the mixing region, the diffuser angle, and the diffuser wall length. D.S.G.

N64-25272 Tulane U., New Orleans, La.
FLOW FIELD CHARACTERISTICS IN A MODEL BI-STABLE FLUID AMPLIFIER
Henry F. Hrubecky and Larry N. Pearce *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 351–373 refs (See N64-25253 17-11)
(Contract DA-01-009-AMC-33 (Z))

An experimental investigation of the flow field during intersection and mixing of two different two-dimensional jets under bounded wall conditions was conducted. A model fluid amplifier system was constructed incorporating flexibility in flow and geometric parameters. Pressure and velocity distributions were investigated for three flow conditions: (1) no control flow, (2) control flow great enough to cause incipient switching, and (3) control flow great enough to assure switching. The latter depicts the flow pattern after the combined jets have switched to the opposite wall. D.S.G.

N64-25273 Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.
A HIGH GAIN PROPORTIONAL FLUID STATE FLOW AMPLIFIER
M. B. Zisfein and H. A. Curtiss *In* HDL Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 375–393 refs (See N64-25253 17-11)

Sensitive flows were developed and successfully integrated into a method for high-gain proportional amplification in fluid-state control systems. The concept of separated curved-flow modulation is a useful means of directly amplifying stream momentum while the concept of jet impingement with adjacent-wall entrainment is clearly a powerful means of converting a modulated momentum into large-mass flow gains. Linear proportional differential mass-flow gains of over 220 are obtained with this double-leg elbow amplifier technique over a broad range of element sizes, flows, and output loads. Dynamic and transient response tests, conducted over a broad frequency range from 0.1 to over 1,000 cps, demonstrated the excellent dynamic characteristics of these elements and their applicability to fluid-state systems. Author

N64-25287* Consultants and Designers, Inc., Arlington, Va.
ON THE CHARGED PARTICLE FLOW IN A MAGNETIC FIELD [O DVIZHENII ZARYAZHENNYKH CHASTITS V MAGNITNOM POLE]
B. I. Morgunov 27 May 1964 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 3, Fiz.-Astron., No. 2, 1964 p 3–7
(Contract NAS5-2078)
(NASA-TT-F-8903; ST-PF-10147)

This paper considers the drift equations for an axisymmetrical magnetic field. An approximate integral of exact equations of motion is obtained, and its properties are studied by means of a numerical example. Author

N64-25291 Sandia Corp., Albuquerque, N. Mex.
STANDARD TESTS FOR LAMINAR FLOW DEVICES
R. C. Marsh, W. J. Whitfield, W. E. Neitzel, J. C. Mashburn, and L. C. Trujillo Jun. 1964 34 p refs
(SC-TM-64-637)

This memorandum discusses the need for testing laminar flow devices to assure that they are functioning properly. Detailed procedures are given for testing airflow and for leak checking the final filters, and methods of correcting deficiencies are outlined. Author

N64-25301 Harry Diamond Labs., Washington, D.C.
PROCEEDINGS OF THE FLUID AMPLIFICATION SYMPOSIUM, VOLUME III
May 1964 218 p refs Symp. Held at Harry Diamond Labs., 26–28 May 1964
(AD-602002)

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3. INTERCONNECTION OF FLUID AMPLIFICATION ELEMENTS R. W. Warren p 53–72 ref (See N64-25304 17-11)

4. STAGING OF CLOSED PROPORTIONAL FLUID AMPLIFIERS G. L. Roffman p 73–83 (See N64-25305 17-11)

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N64-25304 Harry Diamond Labs., Washington, D. C.
INTERCONNECTION OF FLUID AMPLICATION ELEMENTS
Raymond W. Warren *In its* Proc. of the Fluid Amplification Symp., Vol. III May 1964 p 53–72 ref (See N64-25301 17-11)

The interconnection of fluid logic elements necessitates that both flow and wave effects be considered. Practical considerations impose additional limitations on the system. Some approaches to the problem of operating within these limitations are discussed. The operation of a wall-interaction fluid amplifier with open controls and with a minimum setback between the stream and the walls is discussed. A decrease in flow in the control on the side of the stream opposite the separation bubble is very effective in switching the stream. Characteristics of the output waves are reported. Techniques used to solve interconnection problems are discussed. Author

N64-25305 Harry Diamond Labs., Washington, D.C.
STAGING OF CLOSED PROPORTIONAL FLUID AMPLIFIERS
Gary L. Roffman *In its* Proc. of the Fluid Amplification Symp., Vol. III May 1964 p 73–83 (See N64-25301 17-11)

A method of staging a closed proportional fluid amplifier for large flow gain is discussed. The amplifier, of which all stages are similar, was designed by considering momentum and continuity of the fluid between stages. The gain of each stage, which is equal to the ratio of the power nozzle area of a stage to the power nozzle area of the previous stage, is calculated to be 5.7. Author

N64-25306 Harry Diamond Labs., Washington, D.C.
ANGULAR VELOCITY REGULATION WITH A FLUID INTERACTION SYSTEM
Joseph M. Iseman *In its* Proc. of the Fluid Amplification Symp., Vol. III May 1964 p 85–129 ref (See N64-25301 17-11)

A two-position control system using no moving parts to regulate the angular velocity of a turbine has been constructed and evaluated. The experimental model uses the two outputs of a bistable fluid amplifier as correction jets, one tending to drive (speed up) a turbine, one tending to load (slow down) the turbine. The amplifier is appropriately switched by the outputs of a pneumatic angular velocity sensor, so that the turbine speed is varied continuously between speeds 2% faster and 2% slower than a nominal, desired speed. The switching characteristics of the bistable fluid amplifier, and the design and operation of the sensor and transmission lines are described and analyzed. Author

N64-25307 Harry Diamond Labs., Washington, D.C.
FLUID AMPLIFICATION TECHNOLOGY: A BIBLIOGRAPHY OF DIRECT CONTRIBUTIONS
Vondell Carter and Jonathan Fine *In its* Proc. of the Fluid Amplification Symp., Vol. III May 1964 p 131–208 refs (See N64-25301 17-11)

Contained in this bibliography are 143 citations of publications and patents considered contributory to the technology of "pure fluid amplifiers," that is, those fluid devices containing no moving parts. Included are reports (industry and Government), theses, papers, articles (journal and periodicals), and patents. Approximately 80% of the material cited has been abstracted. Author

N64-25354 California Inst. of Tech., Pasadena Graduate Aeronautical Labs.
SUPERSONIC SEPARATED AND REATTACHING LAMINAR FLOWS: I. GENERAL THEORY AND APPLICATION TO ADIABATIC BOUNDARY LAYER–SHOCK WAVE INTERACTIONS
Lester Lees and Barry L. Reeves 4 Oct. 1963 80 p refs
(Grant AF-AFOSR-54-63)
(TR-3; AD-437687)

Laminar-boundary-layer–shock-wave interactions are studied in which the pressure rise generated in an external supersonic, inviscid flow is communicated upstream through the boundary layer, and thereby induces flow separation. An integral or moment method is used, in which the first moment of momentum is employed, in addition to the usual momentum integral (zeroth moment). By this means, the velocity and enthalpy profiles are characterized by a single independent parameter not explicitly related to the local static pressure gradient. This method itself is not new, but it turns out that its successful application to separated and reattaching flows hinges on the proper choice of the one-parameter family of velocity profiles utilized to represent the integral properties of the viscous flow. The Stewartson reversed-flow profiles and their Cohen–Reshotko analogs for flows with heat transfer have the qualitatively correct behavior; polynomials do not. The present theoretical calculations agree quite well with the adiabatic laminar-boundary-layer–shock-wave interaction experiments of Chapman and Hakkinen at moderate supersonic speeds. Author

N64-25397 Massachusetts Inst. of Tech., Cambridge Hydrodynamics Lab.
ENCLOSED ROTATING DISKS WITH SUPERPOSED THROUGHFLOW: MEAN STEADY AND PERIODIC UNSTEADY CHARACTERISTICS OF THE INDUCED FLOW
Technical and Final Report
J. W. Daily, W. D. Ernst, and V. V. Asbedian Apr. 1964 115 p refs
(Grants DA-ORD-31-124-61-G5; DA-ORD-31-124-G131)
(R-64-16; AROD-2500-2; AD-443060)

This is a study of enclosed rotating disks with radial outward throughflow superposed on the fluid motion induced by the disk. The report presents information on the flow mechanics in the axial clearance space between the disk and stationary endwall including mean steady velocity distributions and unsteady periodicities. Also included are data on the interactions between fluid and boundaries as evidenced by torque transmission (disk friction) and by radial pressure gradients. A theoretical analysis is presented to predict the steady state values of torque and pressure distribution and is compared with experimental results. Quantitative measurements of unsteadiness and periodicities that result under some conditions are analyzed and compared with previous smoke visualization data. Author

N64-25460 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A METHOD OF MEASURING LOW ABSOLUTE PRESSURES
A. V. Yeryukhin 26 May 1964 5 p Transl. into ENGLISH from Soviet Patent No. 153588, 29 Jan. 1962 p 1–3
(FTD-TT-64-81/1+2+4; AD-601510)

A method of measuring low absolute pressure, which increases measurement accuracy and excludes random error, is described. Measuring is conducted by having mercury flow to the entrance of the capillary of a single-capillary compression manometer. The mercury then gradually rises in the capillary without the measuring volume contacting the vacuum

system in which the gas pressure is determined. Calculations, using the method of least squares, are made at different relations of the mercury level values. I.v.L.

N64-25503 Massachusetts Inst. of Tech., Cambridge
AN ANALYSIS OF MHD CHANNEL ENTRANCE FLOWS USING THE MOMENTUM INTEGRAL METHOD
W. Craig Moffatt Apr. 1964 13 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(MIT-35-P; AD-442772)

This note describes a simple solution for the pressure distribution in the entrance region of a rectangular MHD channel using the momentum integral method. Laminar, two-dimensional, steady, incompressible, low magnetic Reynolds number flow is assumed, with magnetic and electric fields imposed parallel to the short and long channel side walls, respectively. The assumption of a Hartmann-like velocity distribution in the developing boundary layer yields results that are in very close agreement with those found by other investigators using more exact techniques. Author

N64-25532 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
EXPERIMENTAL DETERMINATION OF PRESSURE, TEMPERATURE AND DENSITY IN SOME LAMINAR HYPERSONIC NEAR WAKES
E. J. Softley, E. P. Muntz, and R. E. Zempel May 1964 51 p refs
(Contract AF 04(647)-617; AF 04(694)-222)
(R64SD35; AD-439642)

Measurements of base pressure, and axial distributions of density and static temperature have been obtained for several laminar hypersonic wake flows. Experiments were performed at Mach 12 for Reynolds numbers based on model length of 7×10^5 and 6×10^4 and also at Mach 18 for a Reynolds number of 5×10^4. The pressure results indicate that the base pressure of a cone is a sensitive function of Reynolds number. The temperature measurements support the inclusion in theoretical analyses of the expansion distortion of the boundary-layer profile at the trailing corner of a cone. The temperature measurements also show that the maximum on-axis wake static temperatures appear in the recirculation region. Author

N64-25542 Minnesota U., Minneapolis
SURFACE AND VOLUME SOUND FROM BOUNDARY LAYERS
William C. Meecham [1963] 24 p refs
(Sponsored in Part by ONR)
(AD-439404)

It is shown for turbulent boundary layers that surface dipole sound is in general very much less than volume quadrupole sound. This is so for two reasons: (1) The relative volume sound is increased by several orders of magnitude because of shear-flow enhancement within the boundary layer. (2) The dipole sound intensity is shown, through the use of an image argument similar to that used in the discussion of flat boundary layers, to be reduced by a factor of $(L/R)^2$ where L is the boundary-layer thickness and R is the surface radius of curvature. A discussion of irregular surface bumps shows that such imperfections may be the source of significantly large dipole sound. Author

N64-25554 Union Carbide Research Inst., Tarrytown, N.Y.
RESEARCH ON PHYSICAL AND CHEMICAL PRINCIPLES AFFECTING HIGH TEMPERATURE MATERIALS FOR ROCKET NOZZLES Quarterly Progress Report, Apr. 1–30 Jun. 1964
Robert Lowrie 30 Jun. 1964 113 p refs
(Contract DA-30-069-ORD-2787; ARPA Order 34-63)
(AD-442218)

High-temperature materials for rocket nozzles are examined in terms of gas–solid reactions, physical and mechanical properties such as elasticity and high-temperature creep, purification and sample preparation, and composites. The materials studied were tungsten, graphite, and the refractory carbides and borides of the transition metals. Composite bodies consisting of interpenetrating carbide and metal skeletons hold promise for high-temperature rocket-nozzle applications. G.D.B.

N64-25556 France. Office National D'études et de Recherches Aeronautiques, Chatillon-sous-Bagneux
THE TURBINE-COMPRESSOR UNIT OF THE CONTINUOUS SUPERSONIC WIND-TUNNEL AT MODANE [LE GROUPE TURBINE-COMPRESSEUR DE LA SOUFFLERIE SUPERSONIQUE CONTINUE DE MODANE]
Marcel Pierre 1964 18 p Presented at the Assoc. Tech. Maritime et Aeron., Paris, 11–15 May 1964 In FRENCH
(ONERA-TP-122)

The drive unit of the continuous supersonic wind tunnel consists of a Pelton four-wheel hydraulic turbine, with a power of 45,000 kw, and a 16-stage compressor, with a diameter of 4.30 m. This report describes the unit and emphasizes the particular problems posed by its conception and realization. Trans. by I.v.L.

N64-25575 Princeton U., N.J.
HYDROFOIL INSTABILITY AT LOW MASS DENSITY RATIOS Aerospace and Mechanical Sciences Report No. 670
R. L. Caporali and E. J. Brunelle Mar. 1964 235 p refs
(Contract Nonr-1858(40))
(AD-437679)

This study deals with the low mass–density ratio hydroelastic behavior of fully wetted lifting surfaces of sufficiently high aspect ratio to justify the fundamental assumptions of two-dimensional, unsteady hydrodynamic fluid forces and the concept of a rigid streamwise section. Hence, this study is particularly applicable to lifting surfaces in marine usage. In particular, the strut supports of hydrofoil boats, which operate at subcavitating, speeds may be regarded as typical of the hydroelastic systems toward which this investigation is directed. Author

N64-25616 Northrop Corp., Hawthorne, Calif. Norair Div.
LAMINAR FLOW CONTROL DEMONSTRATION PROGRAM. LFC MANUFACTURING TECHNIQUES Final Report
J. W. Quick Mar. 1964 78 p
(Contract AF 33(600)-42052)
(NOR-61-142; AD-439329)

The manufacturing techniques required to build the laminar flow control differed from those used on conventional turbulent aircraft for two basic reasons: The X-21A wings required extremely smooth wave-free external surfaces, and provisions had to be incorporated for removing by suction a portion of the boundary layer from the wing surfaces. Extensive manufacturing effort was expended in several major areas: (1) the development of panel bonding fixtures and methods to maintain the extreme smoothness criteria of the external wing surfaces; (2) the milling, drilling, and slotting equipment to maintain size and location accuracy of wing slot

and hole patterns; (3) the building-in of the air ducts as part of the basic structure for air passage through the wing; and (4) the development of modulation valves for the suction system. Results of this effort indicate that the manufacture of airplane structure to laminar flow control tolerance is feasible, and that this type of manufacture can be done with the present day state-of-the-art equipment. Appendices are presented that deal with wing assembly sequence, bond fixture perimeters, bond fixture fabrication sequence, bond tool material sketches, a panel trim sketch, tornetic controlled drilling and sawing specifications, tornetic settings and depth control, and saw blade specifications. I.v.L.

N64-25625 Joint Publications Research Service, Washington, D.C.
TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 99
Kuo Shang-p'ing et al 23 Jul. 1964 13 p Transl. into ENGLISH from K'o-Hsueh T'ung Pao (Peking), no. 5, May 1964 p 420–425
(JPSR-25562; TT-64-31834)

Multiple phase vadose research indicates essentially vadose mechanics (a branch of modern fluid mechanics) and is related to the exploration of petroleum and natural gas, and soil conservation, such as the prevention of soil salinization. The development of multiple-phase vadose, oil–water vadose, and physical–chemical vadose research are discussed. Results of this survey indicate the following: (1) Multiple-phase vadose research must be strengthened. (2) The main efforts should be directed at double-phase vadose (especially oil–water vadose in porous media), physical–chemical vadose, mixed-phase oil driving, and soil transformation research. (3) Attention should be directed at the application of a physical analog, a mathematical analog, modern computing technique, mathematical analysis, and on-the-spot experiments for an effective development of multiple-phase vadose research. I.v.L.

N64-25635 Harvard U., Cambridge, Mass.
THE VISCOUS INCOMPRESSIBLE FLOW INSIDE A CONE
Robert C. Ackerberg Dec. 1962 143 p refs
(Contract Nonr-1866(34))
AD-432196)

The viscous incompressible flow inside a cone is analyzed mathematically by formulating the problem and establishing similarity properties of the exact solution. Stokes flow, the search for a potential flow, the inviscid flow near the apex, and the boundary-layer solution are all discussed. G.D.B.

N64-25694 University of Southern Calif. Engineering Center, Los Angeles
SUPERSONIC WIND TUNNEL INVESTIGATION OF THE TURBULENT BOUNDARY LAYER ON AXIALLY SYMMETRIC BODIES
Thomas H. Keesee 27 Mar. 1963 23 p
(Contract W-61-0404-T)
(USCEC-65-52; AD-601976)

This report describes a supersonic wind tunnel investigation of the turbulent boundary layer on three axially symmetric bodies at free stream Mach 1.61, 2.58, 3.30, and 4.50. Steady-state temperature and pressure measurements were made in the boundary layers and on the surfaces of bodies that featured convex, concave, and blunt-convex-shouldered geometries, and transient temperature measurements were made on the surface of a convex-shouldered model cooled with liquid nitrogen. Skin-friction measurements were also made with a floating-element balance. Descriptions of the models, instrumentation, and test program, and a discussion of the difficulties encountered in making some of the measurements are presented. Author

N64-25697 Northrop Corp., Hawthorne, Calif. Norair Div.
IN FLIGHT NOISE MEASUREMENTS PERFORMED ON THE X-21A LAMINAR FLOW AIRCRAFT
R. F. Carmichael and D. E. Pelke Apr. 1964 68 p refs
(Contract AF 33(600)-42052)
(NOR-64-81; AD-439351)

Sound pressure levels measured in flight by six microphones positioned around the left-hand wing of the X-21A laminar flow aircraft are presented. These measurements define the noise levels existing at the wing surface for the Mach number ranges of the aircraft at three widely separated altitudes and four engine throttle settings. Most of the noise sources are identified, and their levels compare favorably with previously developed prediction methods. It is noted, however, that not all predominating noise sources are included in the prediction methods, specifically, engine screech, and one noise of undetermined origin. Also, engine noises are masked at higher Mach numbers by radiated turbulent boundary-layer noise, which has the properties of noise generated by a quadrupole mechanism. In regard to the effects of noise on the maintenance of laminar flow, it is noted that noise spectra possessing intense, relatively narrow band spikes could be more detrimental than flat spectra with higher overall levels. Author

N64-25698 Aeronautical Research Associates of Princeton, Inc., N.J.
HYPERVELOCITY KILL MECHANISMS PROGRAM. AEROTHERMAL PHASE Semiannual Technical Progress Report, 31 Mar. 1964
Coleman du P. Donaldson, K. Evan Gray, Roger D. Sullivan, Richard S. Snedeker, and Dale B. Ruhmel [1964] 8 p
(Contract Nonr-3903(00)(X); ARPA Order 149-60)
(AD-438860)

Theoretical and experimental studies of basic flow phenomena associated with aerothermal kill mechanisms are discussed. As a result of these studies emphasis was placed on solving coupled flow problems. Work on jet impingement, wall jet, and free shear layer studies is also discussed. A study attempting to relate compressible jet flows to incompressible ones is being made. An analytical study of the characteristics of free shear flows is being conducted in order to investigate the mechanism of energy transfer across a mixing region. The growth of a mixing region as a function of Mach number and enthalpy ratio is also being studied. P.V.E.

N64-25724 Applied Physics Lab., Johns Hopkins U., Silver Spring, Md.
TASK R Quarterly Progress Report No. 21, 1 Apr.–30 Jun. 1964
A. A. Westenberg et al [1964] 31 p refs
(Contract NOw-62-0604-c; ARPA Order 22-63)
(SR-4-5; AD-602084)

In the dissociated gas studies, results from a large number of runs to measure the $O\text{-}O_2$ diffusion coefficient in a flow tube are discussed. The general behavior is represented by nonlinear plots of log $(O)/(O)_o$ vs distance, indicating an overall loss of O-atoms that is not first order. Possible causes are discussed. In the molecular beam chemical kinetic studies, experiments with aerodynamic beams of He-Ar mixtures in the prototype apparatus are described. A final design for the crossed beam apparatus is given, and the various specifications of the beams are estimated. Some simple design

criteria for aerodynamic beams are outlined. In the studies of rocket nozzle fluid dynamics, recent experience with the high temperature CO_2 calibration equipment for the fast scanning infrared spectrometer is described. Both a heated free jet and a static cell have been used. Author

N64-25728 Stanford U. Calif.
LINEARIZED THEORY OF TWO-DIMENSIONAL RADIATING GAS FLOW BY A MOMENT METHOD
Ping Cheng Apr. 1964 12 p refs
(Contract AF 49(638)-1280)
(SUDAER-188; AFOSR-64-1002; AD-602684)

The moment (or spherical harmonic) method is applied to multidimensional radiating gas flow problems. The approximate radiation-transport equations are derived, and these equations, along with the hydrodynamic equations for the three-dimensional time-dependent flow, are linearized to approximation equations for a two-dimensional steady flow. I.v.L.

N64-25734* Pennsylvania State U., University Park Ordnance Research Lab.
CAVITATION RESEARCH FACILITIES AT THE ORDNANCE RESEARCH LABORATORY OF THE PENNSYLVANIA STATE UNIVERSITY
J. William Holl [1964] 8 p refs Presented at the Symp. on Cavitation Res. Facilities and Tech., Fluids Eng. Div. Conf., Am. Soc. of Mech. Engr., Philadelphia, 18–20 May 1964
(Grant NsG-85-60; Contract NOw-63-0209-c)

Major emphasis is placed on the NASA ultra-high-speed cavitation tunnel, which has a maximum speed of 332 fps in the 1.5-in.-diam test section, and a maximum stagnation pressure of over 1,200 psia. The purpose of the tunnel is to study the factors that control the states of incipient and desinent cavitation. The entire tunnel circuit is made of stainless steel, except for the Lucite (or Pyrex) test section and the bronze centrifugal pump. The small amount of corrosion in the system, coupled with a bypass filtering system, allows for a very clean system compared to the average water tunnel. A flow diagram of the tunnel is presented, calibration and cavitation models are described, and tunnel test results are presented in the form of diagrams of the desinent cavitation number as a function of velocity for the 1.5 ogive nose, the variation of liquid tension with velocity, and cavitation delay time as a function of inception pressure. Also, a brief description of the 48-in. water tunnel is given. I.v.L.

N64-25772* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EFFECT OF HOLE SIZE ON PRESSURE MEASUREMENTS MADE WITH A FLAT-PLATE DYNAMIC-HEAD PROBE
George I. Jaivin 15 Jun. 1964 17 p refs
(Contract NAS7-100)
(NASA-CR-56949; JPL-TR-32-617)

The dynamic-head probe, a device for evaluating the properties of free liquid jets, produced anomalous results when used to evaluate the characteristics of a laminar, uniform velocity profile jet. A comparison of the integrated pressure force on the probe with the measured thrust indicated that inaccurate pressure measurements were the cause. An investigation of the effect of the hole size used in the probe showed that this factor was significant in affecting the accuracy of the pressure measurements. A ratio of the probe hole diameter to the jet diameter of 0.04 was sufficient to eliminate probe effects and to produce a good correlation of experimental and theoretical pressure data. Author

N64-25793 Illinois U., Urbana
GAS-SOLID FLOW
S. L. Soo Charlottesville, Va. U. School of Eng. and Applied Sci. May 1964 81 p refs Presented at Symp. on Single- and Multi-Component Flow Processes, Rutgers U., 1 May 1964
(Contract Nonr-3623(00); Proj. SQUID)
(ILL-13-P)

Studies concern basic aspects of gas–solid suspensions: (1) thermodynamic properties of a gas–solid system, additional irreversibility in momentum transfer, and the meaning of total pressure; (2) consideration of rigorous solution of problems of gas–solid flow and application of momentum integral method to laminar boundary layer motion to determine the velocity and concentration distribution of the solid phase with correlation in terms of a "gas–solid momentum number," N_m; (3) effect of electric charges on flow over a solid wall and correlation in terms of electric Reynolds number and a new "electroviscous number," N_{ev}; and (4) effect of solid particles on mixing length of turbulence. Author

N64-25795 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE EFFECTS OF AMBIENT DISSOCIATION ON FROZEN HYPERSONIC STAGNATION FLOW
J. D. Buckmaster Arnold Eng. Develop. Center Jun. 1964 44 p refs
(Contract AF 40(600)-928)
(AEDC-TR-64-142; AD-601652)

The effects of ambient dissociation on frozen flow in the vicinity of a stagnation point are discussed within the framework of the thin shock-layer theory of Cheng. If the convective heat transfer for an undissociated gas at a particular Reynolds number is known, then the total heat transfer for a frozen dissociated gas can be found for arbitrary values of wall catalycity. In particular, since the undissociated gas solution is known, the results allow a rapid evaluation of the effects of Reynolds number, wall temperature, and catalytic efficiency on the recombination heat transfer. The general effects of ambient dissociation at low Reynolds numbers are discussed, and special consideration is given to the variation of the density-viscosity product and the Schmidt number with local atom mass fraction. For conditions where such variations are unimportant, the effects of ambient dissociation on a variety of flow quantities are calculated. The discussion includes an estimate of the extent of gas-phase reaction at low Reynolds numbers. Author

N64-25798 Webb Inst. of Naval Architecture, Glen Cove, N.Y.
LECTURE NOTES ON SHIP MOTIONS IN IRREGULAR SEAS
Edward V. Lewis and Rutger Bennet Oct. 1963 34 p refs Presented at the 10th Intern. Towing Tank Conf., London, Sep. 1963
(Contract Nonr (G)-0005-63)
(AD-426706)

An outline is given of the procedure usually followed in predicting the response of a ship to an irregular storm sea on the basis of the superposition of its responses to all the components which make up that sea. A nondimensional form of presentation is then developed which makes it possible to visualize and interpret the results of comparative calculations for different ships. The vertical acceleration of a point in a ship subject to pitching and heaving motion is also considered, and a method of estimating the extreme values in irregular seas is presented and compared with full-scale ship data. Author

N64-25799 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
ANALYSIS OF NONSTEADY TWO-PHASE FLOW
George Rudinger and Angela Chang Charlottesville, Va. U. School of Eng. and Applied Sci. Jun. 1964 30 p refs Submitted for Publication
(Contract Nonr-2623(00); Proj. SQUID)
(CAL-88-P; AD-601271)

The techniques for solving problems of nonsteady, quasi-one-dimensional flows by the method of characteristics were extended to flows of suspensions of small solid or liquid particles in a gas. The particles cannot follow the rapid velocity and temperature changes that are produced by pressure waves, and complicated relaxation processes result. Such flows are described by six simultaneous partial differential equations, and their characteristics and associated compatibility equations were obtained. Terms are included to allow for variable duct area, for external forces that may act on the particles or on the gas, and for heat addition to the particles or the gas. To illustrate the application of the results, two flows in a pipe, filled with a suspension of small particles, are analyzed with the help of a small digital computer. In the first example, one end of the pipe is suddenly opened to a low-pressure reservoir, and the resulting expansion wave is computed. In the second example, a piston in the pipe is impulsively accelerated, and the flow between the resulting shock wave and the piston is obtained. A striking feature of this flow is the slow adjustment of the shock strength from its initial to its equilibrium value. Author

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-24239 Lockheed Missiles and Space Co., Palo Alto, Calif.
INTERACTION OF TRAPPED ELECTRONS WITH THE ATMOSPHERE
M. Walt and L. L. Newkirk [1964] 15 p refs
(Sponsored by DASA)

The time dependence of the geomagnetically trapped electron flux resulting from a high-altitude nuclear explosion was calculated assuming that the only forces perturbing the trapped electron motions are collisions with atmospheric constituents. These theoretical results are compared with experimental data obtained with satellites Injun I, Injun III, and Explorer XV. It is concluded that during the latter part of 1962 and the early part of 1963 the major loss mechanism for electrons trapped in regions of $L \lesssim 1.25$ is atmospheric scattering but that other processes dominate the behavior of electrons trapped outside this region. Based on this quantitative knowledge of the loss mechanisms for the region $L \lesssim 1.25$, and utilizing experimental information on the intensity and energy spectrum of the electrons in the natural Van Allen radiation belt, characteristics of the electron source function for that region are deduced. A source strength of at least 5×10^{-9} electrons $cm^{-3}sec^{-1}$ ($E > 40$ kev) is required. The electron source is most intense for low electron energies. Both results are in disagreement with albedo neutron decay theory. Author

N64-24435* National Aeronautics and Space Administration, Washington, D.C.
ON THE RELATIONSHIP BETWEEN SHORT-PERIOD PULSATIONS OF THE EARTH'S MAGNETIC FIELD AND THE INCREASE OF COSMIC-RAY INTENSITY IN THE STRATOSHERE
V. A. Troitskaya *In its* Cosmic Rays Jun. 1964 p 223–234 refs (See N64-24422 17-28) OTS: $5.00

A study was made of the short-period pulsations (SPP) of the earth's electromagnetic field. A high degree of correlation was found between the SPP of the earth's electromagnetic field and the time and variations of cosmic-radiation in the stratosphere. R.T.K.

N64-24557 Joint Publications Research Service, Washington, D.C.
NOCTILUCENT CLOUDS AND THE CYCLIC NATURE OF THE EARTH'S DEVELOPMENT
5 Jun. 1964 27 p Transl. into ENGLISH of Two Articles from Priroda (Moscow), no. 1, Feb. 1964 p 95–99, 107–110 (JPRS-24970; OTS-64-31427) OTS: $0.75

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1. ROCKETS STUDY NOCTILUCENT CLOUDS V. A. Bronshten p 1–9 (See N64-24558 17-21)
2. CYCLICITY: A REFLECTION OF THE EARTH'S DEVELOPMENT G. P. Tamrazyan p 10–24 (See N64-24559 17-12)

N64-24559 Joint Publications Research Service, Washington, D.C.
CYCLICITY: A REFLECTION OF THE EARTH'S DEVELOPMENT
G. P. Tamrazyan *In its* Noctilucent Clouds and the Cyclic Nature of the Earth's Develop. 5 Jun. 1964 p 10–24 (See N64-24557 17-12) OTS: $0.75

The role of pulsation of the field of universal gravitation in the processes of the development of the earth, and the connection of an intensification of the tectonic activity of the earth with the origin of the solar system through definite parts of its orbit is discussed. The cosmic life of the earth and the most important stages of development of the geological processes, climate, and organic life associated with it are presented. N.E.A.

N64-24560* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEASONAL VARIATION OF DENSITY AND TEMPERATURE OVER CHURCHILL, CANADA, DURING SOLAR MAXIMUM
N. N. Spencer, R. L. Boggess, and D. R. Taeusch (Michigan U.). Repr. from J. of Geophys. Res., v. 69, no. 7, 1 Apr. 1964 p 1367–1379 refs
(NASA-RP-217)

Atmospheric density and temperature data obtained through the application of a technique employing radioactive ionization-gage nose-cone surface-pressure measurements have indicated a seasonal variation of these parameters in the auroral zone at a time of maximum solar activity (1958). A density increase by a factor of 2 to 3 in the summer, centered in the 70- to 80-km region, is observed. Correspondingly, the temperature in the same region decreases and shows much less fine structure than for winter conditions. Density data from nine flights and temperature data for five flights are presented. A previously unpublished temperature profile for White Sands, N.M., for the previous solar minimum is presented for comparison. IAA

N64-24591* National Aeronautics and Space Administration. Washington, D.C.
TEMPERATURE MEASUREMENT OF THE FREE ATMOSPHERE TAKING INTO ACCOUNT THE RECOMBINATION OF ATOMS [IZMERENIYE TEMPERATURY SVOBODNOY ATMOSFERY S UCHETOM REKOMBINATSII ATOMOV]
A. F. Chizhov Jul. 1964 14 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 46, 1963 p 76–84
(NASA-TT-F-215) OTS: $0.50

The problem of measuring the temperature in the free atmosphere at altitudes above 100 km is considered when taking into account the recombination phenomenon. The possibility of measuring the temperature of the principal components of the atmosphere by means of mass spectrometers is also considered. The problems associated with measuring temperatures with manometers are treated. In the case of the temperature measurement of atomic components, the possibility of excluding the recombination characteristics of the instrument and its calibration parameters from the final measurement results is shown. Author

N64-24795* National Aeronautics and Space Administration, Washington, D.C.
SURFACE ALBEDO OF LAND AND SEA IN THE ARCTIC
N. T. Chernigovskiy *In its* Actinometry, Atmospheric Optics and Nuclear Meteorol. p 96–102 (See N64-24786 17-21) OTS: $2.75

A systematic study of the reflecting power of the Arctic land surface was begun in 1949. Data on numerous fixed and field observations from 14 polar stations from 1935 to 1957 were processed. The results of these observations are presented. G.D.B.

N64-24814 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
A NEW METHOD FOR ANALYSING ATMOSPHERIC TURBULENCE [UNE NOUVELLE METHODE D'ANALYSE DE LA TURBULENCE ATMOSPHERIQUE]
Gabriel Coupry 1964 17 p refs Presented at the 4th Cong. of the Intern. Council of Aeron. Sci., Paris, 24–28 Aug. 1964 In FRENCH
(ONERA-TR-114)

A new method for analyzing turbulence is discussed. The flights were made by Mystere IV and Mirage III aircraft. An analog method, based on flight-mechanic equations, enabled the magnetic recording of the vertical component of turbulence. A systematic analysis of the steady state is made for each flight, and the power spectra are obtained by an analog method or by multicopying. An analysis of the extension curves makes it possible to obtain quadratic variations, which are compared with those variations determined by the power spectra. Trans. by I.v.L.

N64-24819* Johns Hopkins U., Baltimore, Md.
ROCKET SPECTROPHOTOMETER AIRGLOW MEASUREMENTS IN THE FAR ULTRAVIOLET
W. G. Fastie, H. M. Crosswhite, and D. F. Heath Washington, NASA, Jul. 1964 26 p refs
(Grant NsG-193-62)
(NASA-TN-D-2362) OTS: $0.75

Aerobee rockets carried far-ultraviolet spectrophotometers to an altitude of about 210 km. The experimental data obtained from these flights are presented. An interpretation and analysis of some of the data are also presented. The experiments were conducted under normal upper atmospheric conditions, as determined by magnetometer and ionosonde measurements. Author

N64-24835* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATING THE SPECTRAL DISTRIBUTION OF SHORTWAVE RADIATION [ISSLEDOVANIYE SPEKTRAL'NOGO RASPREDELFNIYA KOROTKOVOLNOVOY RADIATSII]
K. Ya. Kondrat'yev et al July 1964 22 p refs Transl. into ENGLISH from Probl. Fiz. Atmosfery, Sb. 2, Leningrad. Univ., 1963 p 67–86
(NASA-TT-F-213) OTS: $0.50

A fairly detailed description of the regular behavior of a shortwave radiation field can be provided experimentally only by a complex observation program. It is still difficult to devise such a program that would be closed in the sense of including the full set of values, particularly those required for comparing the theoretical calculations with observations. One of the most substantial difficulties is the measurement of the aerosol consistency of the atmosphere at various altitudes. The purpose of this work, therefore, was to prepare the apparatus and make observations under a program that would be largely but not completely closed. Author

N64-24908* Consultants and Designers, Inc., Arlington, Va.
ESTIMATE OF SURFACE INCLINATIONS OF EQUAL ELECTRON CONCENTRATIONS IN THE IONOSPHERE BY THE DATA ON IONIZATION DISTRIBUTION WITH HEIGHT
T. S. Kerblay and Z. V. Volshinova 30 Apr. 1964 12 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 1, 1964 p 61–66
(Contract NAS5-2078)
(NASA-TT-F-8691; ST-AI-10130)

Data on surface inclinations of equal electron concentrations are discussed. Especially considered are the inclinations due to different altitudes of equal electron concentrations h_{N_c} at various latitudes of different illuminance (because of latitude distribution of h_{N_c}. In the first case the maximum angles of inclination were 2° to 3°, in the second 3° to 5°. The angles of inclination were calculated by the data on N(h) profiles for a number of stations located at different latitudes, and by h_m, γ_m world maps. It is well known that maps provide smaller absolute values of the inclinations than those calculated according to data on N(h) profiles for separate days. However, the time of appearance and their signs coincide. The conclusion had been derived that h_m, γ_m converted into h_{N_c} maps may be used for estimating the effect of inclination during the propagation of shortwaves. Author

N64-24951 Library of Congress, Washington, D.C. Aerospace Information Div.
SKY ILLUMINATION PHENOMENA Annotated Bibliography, 1957—1963
24 Jun. 1964 206 p refs
(AID-B-64-42; AD-601846) OTS: $14.00 ph

This annotated literature survey of Soviet-bloc research between 1957 and 1963 includes publications on airglow, auroras, noctilucent clouds, zodiacal light, gegenschein, twilight, and instrumentation. Entries are arranged alphabetically by author within each of the subject groups. When the original source is not available, a secondary source is indicated. An introduction, describing the main developments of Soviet research during 1957–1963 precedes the bibliographic entries. An author index is included. G.D.B.

N64-24953 Emmanuel Coll., Boston, Mass.
MEASUREMENTS OF THE EARTH'S SURFACE TEMPERATURE FROM AIRCRAFT

Dieter Lorenz Bedford, Mass., AFCRL, [1963] 31 p ref Transl. into ENGLISH of the publ. "Messungen ber Bodenoberflachentemperatur von Luftfahrzevgen aus" Frankfurt, Univ. für Meteorol. und Geophys., 1 Jul. 1963
(Contract AF 19(604)-8505)
(E-T-G-63-34)

The theory of measuring the surface temperatures of lands and waters by means of their long wavelength emission is reviewed, and two measuring instruments based on this principle are evaluated. One is a laboratory-constructed instrument, Surface Radiometer II, that performed quite well from an aircraft in spite of its high weight and its power requirements; the other is the Barnes Infrared Thermometer 14-312 that was found to vary considerably from the manufacturers specifications, but whose small size, low weight, and low power-consumption characteristics are advantageous. Few actual measurements were undertaken, but preliminary results indicate that airborne measurement of surface temperatures may be useful for selecting sites for aircraft runways or roads. M.P.G.

N64-24965* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
GLOBAL DISTRIBUTION OF THE NET ENERGY BALANCE OF THE ATMOSPHERE FROM TIROS RADIATION DATA
S. I. Rasool Repr. from Science, v. 143, no. 3606, 7 Feb. 1964 p 567–569 refs
(NASA-RP-225)

An analysis is presented of the radiation data from Tiros II and Tiros III in order to obtain the monthly averages of the global distribution of the total outgoing radiation from the earth. Some information regarding the regional variations in the energy balance of the earth atmosphere has been obtained. For this study of energy balance the climatological estimates of Budyko were used. The energy balance of corrected values of incoming energy and Tiros-measured values of outgoing energy is plotted, and the plots are presented. IAA

N64-24971* Southwest Center For Advanced Studies, Dallas, Tex.
ATMOSPHERIC TIDES AND ASSOCIATED MAGNETIC EFFECTS
J. A. Fejer Repr. from Rev. Geophys., v. 2, no. 2, May 1964 p 275–309 refs
(Grant NsG-269-62)

The dynamical theory of atmospheric tides and its relation to observations on the ground and in the upper atmosphere are reviewed briefly. The lunar tidal oscillations of atmospheric pressure observed on the ground are thought to be almost entirely due to gravitational forces, whereas the solar tidal oscillations are believed to be mainly caused by solar heating. Previous theories of resonant, gravitational excitation of the solar tidal oscillations are not consistent with models of the upper atmosphere obtained from rocket measurements. Tidal oscillations at ionspheric heights are inadequately known experimentally and are inadequately explained by present theories, which neglect viscous losses and the ionized nature of the upper atmosphere and whose linear approximations break down at ionospheric height. The dynamo theory attributes the quiet-day variations of the geomagnetic field to tidal oscillations at ionspheric height. The theory has been used either to derive the magnetic variations from an assumed tidal wind system or to derive the tidal wind system from the observed magnetic variations. The results of both types of calculations lend broad support to the dynamo theory, although neither approach is free of arbitrary assumptions. The additional daily magnetic variations observed during magnetically disturbed days are particularly intense in the auroral zone. These variations are believed to be caused by some form of interaction of the solar wind with the geomagnetic field, but the nature of the interaction is not yet known with certainty. Various proposed theories of these daily disturbance variations are described, and one is discussed in detail. This theory predicts that the generating mechanism responsible for the daily disturbance variations is present, in reduced strength, even on magnetically quiet days. Observations tend to confirm this conclusion. Author

N64-25012* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEFORMATION OF THE GEOMAGNETIC FIELD BY THE SOLAR WIND
Gilbert D. Mead Repr. from J. Geophys. Res., v. 69, no. 7, 1 Apr. 1964 p 1181–1195 refs
(NASA-RP-219)

The three-dimensional numerical solution to the Chapman–Ferraro problem of a steady solar wind perpendicularly incident upon a dipole field is applied to obtain a simple spherical harmonic description of the distorted field. From this, a three-dimensional picture of the field-line configuration within the magnetosphere is given. The field lines are found to be compressed on both the daytime and nighttime sides. The behavior of the field lines on the daylight side changes abruptly as a critical latitude is approached, which ranges between 80° and 85°, depending on the intensity of the solar wind. Above this latitude, lines originating along the noon meridian pass over the north pole and cross the equator along the midnight meridian. IAA

N64-25081 Kikuna Geophysical Observatory (Sweden)
DEPENDENCE OF AURORAL ZONE SATELLITE SCINTILLATION ON GEOMAGNETIC ACTIVITY
Ludwik Liszka 16 Jan. 1964 21 p refs
(Contract AF 61(052)-678)
(SR-3; AFCRL-64-267; AD-436835)

The dependence of auroral-zone satellite scintillation on geomagnetic activity is discussed. The scintillation phenomenon depends both on the time of observation and on magnetic activity, so that the scintillation index S has to be considered as a function of two variables: the geomagnetic K-index and the time of observation. The shape of this function of two variables may be explained by assuming diurnal changes in the scintillation rate spectrum. Author

N64-25082 Kikuna Geophysical Observatory (Sweden)
THE GEOGRAPHICAL DISTRIBUTION OF SATELLITE SCINTILLATION ACTIVITY ABOVE NORTHERN SCANDINAVIA Scientific Report No. 4
Ludwik Liszka 10 Feb. 1964 19 p refs
(Contract AF 61(052)-678)
(AFCRL-64-268; AD-436836)

The geographical distribution of scintillation activity above northern Scandinavia was studied. The apparent agreement obtained between contours of constant scintillation activity and lines L= const may be interpreted in terms of a connection between the scintillation phenomenon and the radiation belt. Author

N64-25118* National Aeronautics and Space Administration, Washington, D.C.
THE ELECTRON COSMIC STATION [KOSMICHESKAYA SISTEMA "ELECTRON"]
Jul. 1964 8 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR), v. 2, no. 3, May–Jun. 1964 p 355–359
(NASA-TT-F-9040)

A complete list of the equipment mounted on Elektron 1 and Elektron 2 is presented. Elektron 1 equipment consists of equipment for the study of the soft corpuscular radiation; a beacon system for studying the electromagnetic properties of the ionosphere and of interplanetary space; and ballistic piezoelectric micrometeorite detectors. Elektron 2 equipment consisted of an electrostatic spherical analyzer for recording electron and proton energies; two ferrosonde magnetometers for measuring three mutually perpendicular magnetic field components; X-ray counters for recording the X-ray radiation from the sun in the ranges from 2A to 8A and from 8A to 18A; equipment for studying the composition of cosmic rays and the temporal variations in the fluxes of various groups of nuclei; equipment for recording cosmic radio radiation at the frequencies of 725 kc and 1,525 kc; and a charged particle trap. The following equipment was mounted on both Elektron 1 and Elektron 2: a set of instruments for studying the earth's radiation belts; a mass spectrometer for studying the ionic composition of the atmosphere at great heights; and solar cells for investigating their ability to function under conditions of cosmic space. I.v.L.

N64-25215 Army Missile Command, Huntsville, Ala.
JET STREAMS OVER THE USSR
Nina A. Stepanova 25 Mar. 1964 79 p refs
(RR-TR-64-2; AD-602082)

This report presents data obtained through studies of jet streams over the USSR, the character of turbulence under various aerological conditions and types of stratification in jet streams, and the amounts of energy in jet streams. Author

N64-25216 Army Missile Command, Huntsville, Ala.
TEMPERATURE REGIME IN THE UPPER LAYERS OVER THE USSR
Nina A. Stepanova 25 Mar. 1964 94 p refs
(RR-TR-64-3; AD-602388)

This report presents data obtained through the study of temperature conditions in the upper air layers over the U.S.S.R. The influence of water vapor, carbon dioxide, and cosmic dust on temperature variations is outlined. While one scientist concluded that cosmic dust is the principal factor stimulating ascending movements of air in the stratosphere, still no agreement exists between scientists as to the laws governing temperature variations in the stratosphere. Author

N64-25228 Stanford Research Inst., Menlo Park, Calif.
VARIATIONS OF SATELLITE DAYTIME RADIATION DATA WITH VIEWING GEOMETRY
W. Viezee, R. L. Mancuso, and P. A. Davis Jun. 1964 36 p refs
(Contract AF 19(628)-2777)
(SR-3; AD-601864)

Data obtained from the solar-reflectance channels of Tiros III are examined for a region that was scanned twice within a few minutes as a result of a change in the scanning mode of the radiometer. The data analyses indicate that signals received for scattering angles of 60° to 70° are significantly stronger than those for the angles of 130° to 160°. The difference between albedos for these two ranges of scattering angles was largest for an area of relatively clear skies. The variation of albedo with the scattering angle was more pronounced for the broad solar channel than for the visible channel. Potential limb effects for a partly cloudy sky are estimated in terms of cloudiness, effective temperature, and albedo. Atmospheric effects are neglected. It is shown that effective temperatures from an ideal infrared window could decrease by more than 5° K, while the albedos from a solar-reflectance channel could increase by more than 10% for a typical increase (40°) in the radiometric nadir angle of a scan pattern. Author

N64-25285* Consultants and Designers, Inc., Arlington, Va.
ON THE X-RAY EMISSION IN THE AURORA ZONES
A. I. Yershkovich 21 May 1964 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 2, Mar.–Apr. 1964 p 412–414
(Contract NAS5-2078)
(NASA-TT-F-8901; ST-IS-10143)

A method for calculating the X-ray emission of the polar aurora zone of a planet is described. Given the spatial distribution of the intensity of this emission and the density of the emission, the latitude (λ_*) over which the planet's aurora zone is located can then be estimated. For an approximate estimate of the magnetic moment of the planet, the following correlation may be used: $M = (8\pi\rho_k)^{1/2} R^3 v_k / \cos^6\lambda_*$, where R is a planet's radius, ρ_k is the density of the corpuscular flux; and v_k is its velocity. Such an estimate is useful in the case when direct measurements of the magnetic field, with the aid of a magnetometer, are impossible for one reason or another—for example, when the spacecraft passes beyond the planet's magnetosphere. I.v.L.

N64-25286* Consultants and Designers, Inc., Arlington, Va.
THE SPORADIC E-LAYER OF THE IONOSPHERE AND THE DAILY VARIATIONS OF THE EARTH'S MAGNETIC FIELD [SPORADICHESKIY SLOY E IONOSFERY I SUTOCHNYYE VARIATSII MAGNITNOGO POLYA ZEMLI]
O. Ovezgel'dyyev and L. P. Korsunova 28 May 1964 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 2, 1964 p 411–412
(Contract NAS5-2078)
(NASA-TT-F-8902; ST-AI-GM-10146)

The processing of data pertinent to the sporadic E-layer and the daily variations of the earth's magnetic field is discussed. The processed data were obtained in Ashkhabad for the period May–August, 1962. A preliminary conclusion is that the emergence, at any time of the day, of the intense sporadic E-layer does not exert any basically significant effect on the daily variations of the earth's magnetic field. I.v.L.

N64-25288* Consultants and Designers, Inc., Arlington, Va.
ON A POSSIBLE MAGNETIC FIELD STRUCTURE OF THE GEOEFFECTIVE CORPUSCULAR FLUX ACCORDING TO MEASUREMENTS ON "MARINER-II" [O VOZMOZHNOY STRUKTURE MAGNITNOGO POLYA GEOEFFEKTIVNOGO KORPUSKULYARNOGO POTOKA PO IZMERENIYAM NA "MARINER-II"]
E. I. Mogilevskiy 29 May 1964 19 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 2, 1964 p 213–223
(Contract NAS5-2078)
(NASA-TT-F-8904; ST-SP-PF-10148)

A spatial model of the geomagnetic field of a geoeffective solar corpuscular flux during a geomagnetic disturbance is presented on the basis of magnetic field measurements on Mariner II. Qualitative considerations and certain quantitative estimates showed that the observed magnetic field pattern agrees satisfactorily with the model of a solar corpuscular stream with a force-free magnetic field. Author

N64-25327 DECO Electronics, Inc., Cambridge, Mass.
INVESTIGATION OF IONOSPHERIC OBLIQUE SOUNDER DATA Scientific Report No. 1
David Davidson and Robert M. Gallant 2 Apr. 1964 89 p refs
(Contract AF 19(628)-3267)
(AFCRL-64-408; AD-602402)

During October and November 1962, simultaneous vertical HF ionospheric soundings were taken at Midway, Johnston, and Palmyra Islands. This report uses the observed vertical soundings to predict oblique propagation, using four methods, for the Midway–Palmyra path (3000 km). The first two methods are the CRPL transmission curve technique and that proposed by Kobayashi. One-hop MUF's predicted for these two methods were found to average 4-percent higher than observed values. The CRPL method is the simpler to apply. The third method uses an analog computer, programed with the Hamilton ray equations, to plot ray paths. Virtual heights observed at path midpoint are reduced to electron density profiles for use by the computer. In the fourth method the computer uses the profiles at the path end-points, in addition to midpoint, and linearly interpolates electron density. The ray path behavior for the last two methods is then used to predict one-hop and multiple-hop MUF's. With the third or midpoint-only method the predicted MUF's averaged 8-percent higher than the observed, and with the last or triple-point method the difference was reduced to 1-percent. Author

N64-25328 Harvard Coll. Observatory, Cambridge, Mass.
INVESTIGATION OF THE OUTER IONOSPHERE BY OBSERVATIONS OF EXTRATERRESTRIAL LOW-FREQUENCY NOISE IN SPACE VEHICLES Final Report
G. R. Huguenin Mar. 1964 29 p refs
(Contract AF 19(604)-6120)
(AFCRL-64-357; AD-601770)

A total of 41 radiometers for 15 separate rocket probes and satellites were instrumented. Of the 41 radiometers, 19 were flown, 20 were canceled, and 2 were reserved for SATAR, which is yet unflown. Of the 19 radiometers flown, data of some usefulness were obtained from 10. In no case was any failure of the radiometer in space attributable to the instrumentation developed. A considerable amount of knowledge was gained in the use of the ionospheric leakage and propagation ground station. However, due to the low orbits of the satellites the results obtained are inconclusive, although very encouraging. Also, theoretical studies are discussed. Models of the galactic background were constructed, and an understanding was gained of planetary nonthermal radiation and solar nonthermal burst radiation. Both the models and the radiation observations represent a considerable theoretical basis for an observational program of long wavelength radio astronomy in space. The large amount of original work conducted in ionospheric focusing and Z-mode propagation provides a potential tool for obtaining highly directive observations with modest satellite payloads. I.v.L.

N64-25368 Kiruna Geophysical Observatory (Sweden)
AURORAL ZONE FARADAY ROTATION STUDIES
Ludwik Liszka 30 Dec. 1963 36 p refs
(Contract AF 61(052)-678)
(AFCRL-64-266; SR-2; AD-437149)

The analysis of Faraday rotation observations made for 20 months at Kiruna Geophysical Observatory, lat. = 67°.8N, long. = 20° E, was carried out with emphasis on special properties of the auroral zone F-region, especially the geomagnetic field and variations in the total electron content. The direction of the horizontal component of the geomagnetic field in the F-region differs by about 6° from that extrapolated from the components at ground level. Increases of the rate of Faraday rotation observed in the auroral zone were explained in terms of large horizontal variations of the total electron content. The amplitude of these variations is about one order of magnitude larger than those observed at middle latitudes. Author

N64-25474 California U., Los Angeles
OPTICAL STUDIES OF THE ATMOSPHERE Final Report
Zdenek Sekera Apr. 1964 13 p refs
(AFCRL-64-366; AD-602004)

A balanced program of experimental and theoretical investigations of the problems encountered in atmospheric optics has been pursued. Formal solutions for the problem of radiant energy transfer in a physically realistic medium exhibiting both scattering and true absorption have been obtained. New instruments to be used in the study of intensity and polarization of diffuse skylight have been designed and fabricated. Investigation of the effect of a turbid layer on the radiation emerging from a planetary atmosphere has been completed for an idealized case. Author

N64-25489 Space Technology Labs., Inc., Redondo Beach, Calif. Quantum Physics Lab.
OZONE ALTIMETER
Robert S. Fraser Jun. 1964 40 p refs
(Contract AF 04(694)-1)
(Rept.-6121-8728-RU-000; BSD-TDR-64-97; AD-442022)

The characteristics of atmospheric ozone are reviewed. The rates of attenuation of radiant energy by ozone in the atmosphere are computed. A simple error model of the ozone concentration is given for the purpose of computing the accuracy that an ozone altimeter would measure heights. Based on this error model, the ozone concentration has to be specified with a relative error less than 0.03, if the altimeter is to measure heights at the 40-km level with an error less than 100 m. At the present time the ozone concentration can neither be measured nor predicted for operational conditions with such small error. Author

N64-25507* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
THREE-BODY REACTIONS
Charles A. Barth Repr. from Ann. Geophys. (Paris), v. 20, no. 2, Apr.–Jun. 1964 p 182–196 refs Presented at the Symp. on Aeronomy During the IUGG Gen. Assembly, Berkeley, Calif., 21–24 Aug. 1963
(Contract NAS7-100)
(NASA-CR-56783; JPL-TR-32-593)

The experimental technique most useful in studying upper atmosphere three-body reactions is the discharge flow system. The overall reaction rate coefficients of three-body reactions forming molecular nitrogen, nitric oxide, oxygen, nitrogen dioxide, carbon dioxide, and ozone are tabulated. The rate coefficients of three-body reactions that lead to the emission of light have values between 0.001% and 5% of the overall rate coefficients. The reaction mechanisms that lead to light emission almost always involve an intermediate state. Recent experimental evidence challenges the necessity of a collision in converting the intermediate state into the light-emitting state. The only three-body reactions that are important in determining the particle density in the earth's upper atmosphere are the reactions that form molecular oxygen and ozone. The presence of nitric oxide bands in the night airglow of a planet is a sensitive test of the atomic nitrogen density. Three-body reactions that contribute to the night airglow of the earth are the recombination of atomic oxygen to form molecular oxygen and the recombination of nitric oxide and atomic oxygen to form nitrogen dioxide. Author

N64-25539* State U. of Iowa, Iowa City
A STUDY OF CHARGED PARTICLES IN THE EARTH'S OUTER RADIATION ZONE WITH EXPLORER 14
L. A. Frank, J. A. Van Allen, and H. K. Hills Repr. from J. of Geophys. Res., v. 69, no. 11, 1 Jun. 1964 p 2171–2191 refs
(Grant NsG-233-62)

A comprehensive study of the intensities of electrons and protons near the equatorial plane in the earth's outer radiation zone is presented. The data were obtained from Explorer 14 during the five-month period October 1962 through February 1963. Emphasis is on the radial distribution of absolute intensities of protons and electrons and on the time variations of the energy spectrum and radial distribution of electrons. Typical omnidirectional intensities of electrons in the heart of the outer zone (L~4.0, on the equator) are:

$$J_o\,(E_e > 40\ \text{kev}) = 3 \times 10^7\ (\text{cm}^2\text{sec})^{-1},$$

$$J_o\,(E_e > 230\ \text{kev}) = 3 \times 10^6\ (\text{cm}^2\text{sec})^{-1}, \text{ and}$$

$$J_o\,(E_e > 1.6\ \text{Mev}) = 3 \times 10^5\ (\text{cm}^2\text{sec})^{-1}$$

Artificial radiation belts produced by the Soviet nuclear bursts at high altitudes during late October and early November 1962 are also detected, and their time decays are plotted. Author

N64-25565* Pennsylvania State U., University Park
SCIENTIFIC REPORT ON RECOMBINATION AND TRANSPORT IN THE NIGHTTIME F REGION OF THE IONOSPHERE
Thomas P. Quinn 1 Jul. 1964 98 p refs
(Grant NsG-134-61)
(NASA-CR-56827; SR-212) OTS: $8.60 ph

A method by which the recombination coefficient for the nighttime F layer may be determined, and an extension of the method that allows a determination of the drift and diffusion velocities is presented. The relative effects of different assumptions in the analysis on the calculated recombination coefficients are examined. Recombination and diffusion cofficients are determined using data from six ionosphere stations. A strong seasonal dependence for the recombination coefficient is noted, and expressions for summer and winter values are given. It is suggested that the recombination coefficient exhibits no latitude dependence. Vertical drift velocities are of the same order of magnitude as the diffusion velocities. Author

N64-25573* Chicago U., Ill.
EUALUATION OF LIMB DARKENING FROM TIROS III RADIATION DATA Research Paper No. 18
S. H. H. Larsen, T. Fujita, and W. L. Fletcher Aug. 1963 21 p refs
(Grants NsG-333; Cwb-WBG-6)
(NASA-CR-56835) OTS: $2.60 ph

Detailed analyses of radiation data over the Sahara desert, using analog traces (brush records) of the medium-resolution five-channel radiometer on TIROS III, were made in an attempt to evaluate the limb darkening (variation in intensity of outgoing radiation with the direction of propagation). In the technique employed, use was made of the fact that some areas on the earth are scanned twice by the radiometer beam within a few minutes interval as the satellite spins and progresses along its path. Pairs of measurements, where the satellite's radiometer views the same point at a large and a small zenith angle, were combined, and from such measurements a substantial limb darkening was found. Serious influences on the radiation data may occur as a consequence of the scan geometry; these have been carefully examined and taken into account in the interpretation of the data. Author

N64-25611* Consultants and Designers, Inc., Arlington, Va.
EXPERIMENT CONCERNED WITH THE INVESTIGATION OF CONSTANTS OF ION-EXCHANGE PROCESSES IN THE IONOSPHERE [EKSPERIMENT PO ISSLEDOVANIYU KONSTANT IONNO-OBMENNYKH PROTSESSOV V IONOSFERE]
A. D. Danilov and S. P. Yatsenko 3 Jan. 1964 7 p refs Transl. into ENGLISH from Kosmich. Issled., v. 2, no. 2, 1964 p 276–279
(Contract NAS5-2078)
(NASA-TT-F-8906; ST-AI-10150)

This is a description of the first experiment for the study of the rate of basic ion-exchange processes in the ionosphere with the aid of the device "Vypusk vozdukha" of "Air Release" and of a radiofrequency mass spectrometer, installed in a geophysical rocket. As a result of this experiment, it was possible to register only the artificially formed O_2^+ ions. This permitted an estimate of the relative values of the constants of the rate of basic ion-exchange processes in the ionosphere. Author

N64-25644* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF THE UPPER LAYERS OF THE ATMOSPHERE AND SPACE. A BIBLIOGRAPHY [ISSLEDOVANIYE VERKHNIKH SLOYEV ATMOSFERY I KOSMICHESKOGO PROSTRANTSVA]
Jul. 1964 71 p refs Transl. into ENGLISH from Bibliog. Byul. (Moscow), no. 2, 1964 p 3–46
(NASA-TT-F-229) OTS: $1.75

N64-25699 Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Advanced Research Dept.
OPTICAL MEASUREMENTS OF NATURAL AURORA IN THE NORTHERN AURORAL ZONE FROM AN AIRCRAFT PLATFORM
W. P. Boquist, W. N. Hall, and H. E. Underwood 31 Oct. 1963 75 p refs
(Contract DA-49-146-XZ-092)
(EG&G-B-2651; DASA-1458; AD-602017)

An auroral measurements program to study natural auroras by photographic and spectroscopic techniques was carried out during a two-week period in March 1963. The flight missions were scheduled to coincide with the passage, overhead, of an instrumented satellite, designed to transmit radiofrequency signals through the auroras in order to study the transmission properties of the auroras. In general, results of photographic measurements were similar to those expected from typical strong auroras present at that time of year. The photographic data collected during six flight missions show structural variations of the aurora and also show that the auroral phenomena varied significantly from mission to mission. The results of the spectrographic measurements indicate the presence of most of the bands and lines generally observed in nighttime aurora. Author

N64-25705* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
GLOBAL DISTRIBUTION OF THE NET ENERGY BALANCE OF THE ATMOSPHERE FROM TIROS RADIATION DATA
S. I. Rasool Repr. from Sci., v. 143, no. 3606, 7 Feb. 1964 p 567–569 refs
(NASA-RP-225)

The radiation data from Tiros II and Tiros III were analyzed to obtain the monthly averages of the global distribution of the total outgoing radiation from the earth. These data were combined with climatological estimates of the incoming radiation for the same periods to obtain monthly averages of the regional distribution of the net energy balance. The results show that these data could be useful in studies of the meridional circulation and the evolution of large-scale weather systems. Author

N64-25712* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RADIANCE OF THE EARTH AND ITS LIMB IN THE MIDDLE ULTRAVIOLET
William C. Hrasky and Thomas B. Mc Kee Washington, NASA, Jul. 1964 37 p refs
(NASA-TN-D-2355) OTS: $1.00

The equation for the calculated radiance in the middle ultraviolet region (0.20μ to 0.30μ) emerging from the top of a 200-k-thick spherical atmosphere is derived from the geometry and physics of Rayleigh scattering and ozone absorption. The radiance is that which would be seen by a hypothetical observer 400 k above the earth. The radiance is calculated for various wavelengths and sun orientations for planar scans across the earth's disk. The various atmospheric phenomena affecting the results are shown and discussed. Author

N64-25731* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DENSITIES OBTAINED FROM DRAG ON THE EXPLORER 17 SATELLITE
R. Bryant Repr. from J. of Geophys. Res., v. 69, no. 7, 1 Apr. 1964 p 1423–1425 refs
(NASA-RP-218)

Data are presented on orbit elements for the active experiment lifetime of the Satellite Explorer 17 (1963 Alpha 9) and are applied to the determination of atmospheric density in the region of the perigee of the satellite. The differential corrections, using minitrack interferometer data, covering data arcs of approximately seven days, were carried out. A table containing orbital data is given. Graphs showing density versus converted zenith angle and density versus local solar time are presented. A table containing information useful for further study of the shape of the diurnal bulge is also given. Tabulated in order are epoch, rate of change or period in seconds per day, density at one-half scale height above perigee height, adjusted density at 270 km, local solar time at perigee, declination of perigee, difference in declination between perigee and the sun, zenith angle, and average 10.7-cm solar flux for the data arc. I.A.A.

N64-25738* California U., Los Angeles Inst. of Geophysics and Planetary Physics
ORIGIN OF DIAMONDS IN THE CANYON DIABLO AND NOVO UREI METEORITES
Neville L. Carter and George C. Kennedy Repr. from J. of Geophys. Res., v. 69, no. 12, 15 Jun. 1964 p 2403–2421 refs
(Grant NsG-314-63; Contract Nonr-233(28))

Detailed optical studies of the textural features of several hundred diamonds and associated phases in three specimens of the Canyon Diablo meteorite and one specimen of the Novo Urei achondrite were made. Diamonds in the Canyon Diablo are associated exclusively with troilite, graphite, and schreibersite, and they occur both in shock-heated and unreheated specimens. Diamonds in the Novo Urei occur in pods and lenses interstitial to slightly deformed olivine and and pyroxene crystals. The diamonds, once formed, were shattered and partially graphitized. X-ray and electron microscope studies show that the diamond bodies, which range in size up to 2 mm in Canyon Diablo, are now composed of 0.5-μ subindividuals with nearly random orientations. The evidence obtained from these studies indicates that the diamonds probably precipitated as a stable phase from a late-freezing residuum composed primarily of iron sulfide, iron phosphide, and carbon, under high gravitational pressures. The diamonds were subsequently shattered, distorted, and partially graphitized, possibly from a pressure drop due to the disruption of the large parent body. The physical evidence against the theory that the diamonds originated by high temperature and pressures due to shock is convincing. Author

N64-25771* Michigan U., Ann Arbor Space Physics Research Lab.
AN INTRODUCTION TO THE THEORY AND DATA REDUCTION METHOD FOR THE PITOT-STATIC TECHNIQUE OF UPPER ATMOSPHERE MEASUREMENT
R. W. Simmons Mar. 1964 140 p refs
(Contract NAS4-3335)
(NASA-CR-56411; RS-1) OTS: $10.50 ph

This paper serves to briefly introduce the terminology and nature of the upper atmosphere for data reduction. The theory, equations, conversions, and transformation required in data processing are developed in detail. Discussed is the upper atmosphere as it appears today. A comparison and brief description of upper atmosphere neutral particle measurements are given. The theory of aerodynamic upper atmosphere neutral particle measurement is described. Other items examined are the pitot-static probe, determination of ambient atmospheric density from impact gage pressure, determination of ambient atmospheric pressure, and determination of ambient atmospheric temperature. G.D.B.

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-24348 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE STATISTICAL FUNDAMENTALS OF IRREVERSIBLE THERMODYNAMICS
Hans Ziegler 28 May 1964 56 p refs Transl. into ENGLISH From Ing.-Archiv. (Berlin), v. 31, no. 5, 1962 p 317–342
(RSIC-187; AD-601907)

Defining the thermodynamic macrosystem as being composed of a multitude of microsystems that are holonomic, scleronomic, conservative, and that include gyroscopic forces, the basic principles of irreversible thermodynamics are developed by using the statistical method. The processes discussed here are quasi-static, i.e., processes that progress so slowly that they may be regarded as proceeding from one equilibrium state to another. D.S.G.

N64-24382 Washington U., Seattle Heat Transfer Lab.
THE EFFECT OF THE ORIENTATION AND MAGNITUDE OF GRAVITY FIELDS UPON FILM BOILING FROM A FLAT PLATE
C. A. Heath and C. P. Costello May 1964 128 p refs
(Grant NSF-GP-530)

The film boiling phenomenon is observed for high values of temperature difference between the heater surface and the saturated fluid. Tests are reported for stationary vertical heaters in Freon 113, n-pentane and ethanol, and for stationary horizontal heaters in n-pentane and ethanol. It is shown that at high

values of temperature difference the present theories for film-boiling from vertical heaters are not adequate at distances far from the heater leading edge, due to turbulent effects. The heat-transfer predictions for film-boiling from horizontal heaters can be validly applied to vertical heaters under these conditions. Tests were conducted upon heaters mounted in a centrifuge. The heat-transfer coefficient on the outermost heater surface is uninfluenced by centripetal acceleration. An earlier analysis of film-boiling from flat plates is shown to be a valid model subject to a geometrical modification. Author

N64-24524 Joint Publications Research Service, Washington, D.C.

THE RELATION BETWEEN THE THERMAL INERTIA FACTOR OF A SYSTEM OF BODIES AND THE ACTION OF THE EXTERNAL MEDIUM ON THIS SYSTEM

V. I. Kochurov *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 178–185 refs (See N64-24506 17-09) OTS: $3.50

It is assumed that the system of bodies under consideration consists of *n* parts whose materials may be different, that within the limits of each part of the system the thermal properties of the material are constant, and that within the temperature limits considered they are independent of the temperature. On transition from one part of the system to another the temperature changes discontinuously. Within the system, the heat-transfer process is subject to the Fourier law. On the boundary of the system, the heat exchange with the ambient takes place in accordance with Newton's law. It is shown that under these conditions there is a relation between the rate of the regular regime of the first kind, *m*, and the heat-transfer coefficient. R.T.K.

N64-24586 General Electric Co., Philadelphia, Pa. Missiles and Space Div.

THE DIRECT MEASUREMENT OF STATIC TEMPERATURES IN SHOCK TUNNEL FLOWS

E. P. Muntz and Shirley J. Abel Apr. 1964 41 p refs
(Contract AF 04(694)-222)
(R64SD25; AD-436700)

A technique for measuring static temperatures in shock tunnel flows is described. It is based on the electronic excitation of nitrogen molecules by a beam of high-energy electrons. The resulting spontaneous emission or electroluminescence has a spectral intensity distribution that can be related to the gas static temperature. A method has been devised to measure this intensity distribution during the short test time availabe in a shock tunnel. From such a measurement the gas temperature can be deduced by the methods outlined in the text. Author

N64-24592* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HYPERSONIC SHOCK-HEATED FLOW PARAMETERS FOR VELOCITIES TO 46,000 FEET PER SECOND AND ALTITUDES TO 323,000 FEET

Paul W. Huber Washington, NASA, Dec. 1963 76 p refs
(NASA-TR-R-163) OTS: $2.00

Real-air hypersonic-flow parameters are presented in tabular and graphical form for flight in the earth's atmosphere as a function of flight velocity and flight altitude. Thermochemical equilibrium-flow properties are given for the inviscid normal shock and stagnation point, and both equilibrium and frozen-flow parameters, including electron concentration, are listed for the far wake of the inviscid stagnation streamline. Plots of election collision frequency and electrical conductivity in the normal shock and wake plasmas are also included. The tabulations are made for 12 flight altitudes, ranging from 35,900 ft to 322,900 ft and for flight velocities and shock-heated gas temperatures encompassing those encountered in return from planetary missions. Included are discussions of the applicability of the computed parameters to a given problem, and effects due to the uncertainties in the input data for ambient air. Author

N64-24681 Chicago U., Ill. Hydrodynamics Lab.

A NOTE ON AN ANALOGUE OF THE MONTGOMERY STREAM FUNCTION

Dave Fultz *In its* Res. on Hydrodynamic Analogues of Large-Scale Meteorol. Phenomena Apr. 1964 p 101–107 refs (See N64-24678 17-21)

The possibility of calculating an analog of the Montgomery isentropic acceleration potential using the altimeter correction potential using the altimeter correction charts by which the pressure fields are represented is demonstrated. A single-scalar analysis on the temperature surfaces is sufficient to form the basis for vertical velocity calculations in contrast to the difficulty in attaining accurate and consistent analyses by kinematic methods. M.P.G.

N64-24683 Chicago U., Ill. Hydrodynamics Lab.

EXPERIMENTAL INVESTIGATIONS OF THE SPECTRUM OF THERMAL CONVECTIVE MOTIONS IN A ROTATING ANNULUS

D. Fultz, J. Kaiser, M. Fain, R. E. Kaylor, and Joyce Weil *In its* Res. on Hydrodynamic Analogues of Large-Scale Meteorol. Phenomena Apr. 1964 p 2B1–2B89 refs (See N64-24678 17-21)

A series of experiments designed to survey the overall spectrum of types of motion exhibited by a baroclinic fluid in the form of a cylindrical annulus contained between two concentric cylinders that rotate rigidly at a rate Ω are described. A variety of cases are presented with temperature traces and photographs for transitions, normal baroclinic waves, vacillations of several types, and for several special and unusual wave types such as wave pulses, interior waves, easterly cusp waves, alternate vortices, minor propagating waves, and high-frequency oscillations. M.P.G.

N64-24820* North Carolina State Coll., Raleigh

ON THE TRANSPORT PROPERTIES OF A PARTIALLY IONIZED GAS IN THE PRESENCE OF ELECTRIC AND MAGNETIC FIELDS

H. A. Hassan Washington, NASA, Jul. 1964 21 p refs
(Grant NsG-363)
(NASA-TN-D-2369) OTS: $0.50

The transfer equations as given by Burgers are used to give explicit expressions for the diffusion velocities, the heat flux vectors, and the stress tensors of the constituents of a partially ionized gas. The calculation takes into consideration the presence of electric and magnetic fields and pressure, temperature, concentration, and velocity gradients. The results correspond to what is normally referred to as a "second approximation." Author

N64-24828* Electro-Optical Systems, Inc., Pasadena, Calif.

RESEARCH PROGRAM RELATED TO VAPOR THERMIONIC CONVERTERS FOR NUCLEAR APPLICATIONS

A. O. Jensen Washington, NASA, Jul. 1964 110 p refs
(Contract NAS3-2529)
(NASA-CR-77) OTS: $2.50

The objective of this program is to study the long-term effects at high temperature on the surface crystal structure

of cesiated molybdenum emitters for use in thermionic converters. This final report documents the results of a four-point program involving the following: (1) sample processing; (2) grain growth in vacuum and cesium environments; (3) long-term cesiated emission from substrates undergoing crystal changes; and (4) electron-emission microscope examination of initially polycrystalline material that had been subjected to high-temperature operation. D.S.G.

N64-24935 California U., Berkeley
TEMPERATURE DISTRIBUTION AND THERMAL STRESSES Final Report
P. T. Lyman and J. L. Meriam Washington, NAS-NRC, Jun. 1964 40 p refs
(Contract NObs-78634)
(SSC-152; AD-601593)

The purpose of the investigation was to extend the existing knowledge of thermal stresses in ship structures by the study of both physical and mathematical models. The physical floating model was a 10-ft welded box beam simulating the main hull girder of a transversely framed cargo ship. It was subjected to various temperature environments above water, and thermal stresses were measured with foil strain gages. The results of these tests showed excellent agreement at sections remote from the ends of the model with a strength-of-materials approach modified to include any arbitrary transverse temperature distribution. A finite-difference solution to the governing equations of thermoelasticity was developed for two-dimensional plates and extended to a folded-plate type of box girder. Solutions were obtained for a variety of thermal conditions with temperatures varying vertically, transversely, and longitudinally. Accurate comparisons were made with both the experimental and the strength-of-materials results. Author

N64-24957 Tokyo U. (Japan) Aeronautical Research Inst.
A GAS-FLOW DIFFERENTIAL THERMAL ANALYSIS APPARATUS FOR STUDYING THERMAL DEGRADATION OF HIGH POLYMERS
Hirotaro Kambe, Shoichi Igarashi, Ikuro Imanishi, and Osamu Yamamoto Feb. 1964 7 p refs
(Rept.-379)

A gas-flow differential thermal analysis (DTA) apparatus, designed and constructed in this laboratory, for studying thermal degradation of high polymers is described. The DTA apparatus featuring atmosphere control has two distinct characteristics,—flat metal cells and thermocouples spot-welded directly to the cell. The changes in thermal properties, due to physical and chemical reactions for a linear polyethylene Marlex 50 were measured by this DTA apparatus. In a heating DTA curve, an exothermic peak due to the oxidation of polyethylene was observed at about 180° C while the sample was heated at a constant rate of about 1° C/min. in a stream of oxygen. It is found that the amount of crystalline region in polyethylene decreases as a result of the oxidation above its melting point. Author

N64-24988* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HEAT TRANSFER TO A SEEDED FLOWING GAS FROM AN ARC ENCLOSED BY A QUARTZ TUBE
Chester D. Lanzo and Robert G. Ragsdale Repr. from Proc. of the 1964 Heat Transfer and Fluid Mec. Inst., 1964 p 227–244 refs
(NASA-RP-227)

Experimental results are presented for combined radiation and forced-convection heat transfer to air containing submicron carbon particles flowing in the annulus of a transparent heat exchanger constructed from two concentric quartz tubes. The heat source was an electric arc contained in the inner tube and stabilized by the vortex-type flow of nitrogen gas. Air flowing through the annular region was made absorptive to thermal radiation by the addition of submicron carbon particles. Measurements of the heat transfer to the air were made for air flowing with and without carbon particles. For arc power levels from 126 to 167 kw, an overall heat balance within ±10 percent was obtained by accounting for the nitrogen enthalpy rise, convection, conduction, and radiation losses, and electrode cooling. IAA

N64-25011* General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
NUCLEAR RADIATION HEATING IN LIQUID HYDROGEN. VOLUME II: EXPERIMENTAL DATA
W. A. Hehs, B. O. Mc Cauley, G. E. Miller, and D. M. Wheeler 30 Jun. 1964 607 p refs
(Contract NAS3-3324)
(NASA-CR-54078; FZK-186-2) OTS: $28.50 ph

Experimental data generated during a study on nuclear-radiation heating of liquid hydrogen and the resultant mixing are presented. The data include boiloff and self-pressurization test and flow-run results. M.P.G.

N64-25041 Garrett Corp., Los Angeles, Calif. AiResearch Manufacturing Div.
DESIGN AND MANUFACTURING DEVELOPMENT OF LIGHTWEIGHT HEAT EXCHANGERS Interim Technical Progress Report, 1 Oct. 1963–29 Feb. 1964
K. O. Parker, C. M. Lee, D. Mc Grath, W. Brown, and E. L. Powell Wright-Patterson AFB, Ohio, Aeron. Systems Div., Feb. 1964 84 p
(Contract AF 33(657)-9340)
(ASD-TR-7-936 (VI); AD-602263)

The final assembly operations for completion of the Cb-1%-Zr, Hastelloy X, and 6061-T6 aluminum test modules are described. The tests performed and preliminary test results are presented. Final assembly operations of the Cb-1%-Zr core disclosed lack of ductility due to excess oxygen in the metal and internal surface imperfections in the tubing that required modifications in forming operations on the tubes at the upper header. The tendency of AGCI braze alloy (50% Au, 25% Ni, 25% Pd) to alloy with Hastelloy X, although less than with stainless steel, dictated a maximum of a single repair cycle using a lower melting temperature alloy. Preplaced braze alloy rings, held in place with a volatile acrylic resin, provided leak-tight tube-header joints in more than 99.5 percent of those attempted on the core. Author

N64-25108* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HEAT TRANSFER WITH RECEDING BOUNDARIES AND OTHER COMPLICATIONS
Simon Ostrach *In* Am. Math. Soc. Lecture Notes Prepared in Connection with the Summer Seminar on Space Math., Pt. III 1963 p 601–700 refs (See N64-25102 17-29) OTS: $17.00 ph

A detailed description of the phenomena associated with the ablation process is presented. The heating mechanism is described, and the physical mechanisms of melting are discussed. Materials that do not have a distinct melting temperature (i.e., glassy materials) and that do not melt before they vaporize are considered. R.T.K.

N64-25193 Radio Corp. of America, Princeton, N.J. RCA Labs.
BASIC RESEARCH IN THERMIONIC CONVERTERS Final Report, 1 May 1962–31 Oct. 1963
James R. Fendley, Jr. and Karl Hernqvist [1963] 18 p refs
(Contract Nonr-3826(00)FBM)
(AD-425081)

Apparatus and measurement techniques for studies of the effects of adding noble gases to operating cesium vapor thermionic converters are described. Experimental results on the effect of adding helium and argon at pressures up to several tens of torr are given. The thermionic converter operating in the low-temperature arc mode is relatively insensitive to noble gas additives. The observed effects of gas dosing are small and can be summarized as follows: The discharge becomes more stable, and the glow region in the interelectrode space becomes more uniformly distributed. The electron transport properties of the diode are adversely affected at high current densities and large electrode spacings. The output voltage at low current levels increases upon introduction of noble gases. Theoretical interpretations of these results are described.
Author

N64-25238 Rome Air Development Center, Griffiss AFB, N.Y.
ULTRASONIC CONVECTIVE COOLING
John E. McCormick and Thomas W. Walsh May 1964 17 p refs
(RADC-TDR-64-179)

This report discusses research investigation of ultrasonic cooling techniques. Natural and forced convective cooling parameters were measured, with and without the application of ultrasonic agitation. It was experimentally determined that application of the technique resulted in as much as a threefold improvement in heat transfer. Comparisons of the effectiveness of the various modes of agitation were drawn. The heat transferred increases with increase in vibrational frequency. Conclusions concerning the potential worth of the technique, as applied to electronic equipment, are included in the report. One possible application is in the area of high power tubes, where a possible increase in lifetime, or increased power output, may be obtained.
Author

N64-25276 Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.
SPACE ENVIRONMENT SIMULATOR CRYOGENIC SHROUD HEAT ABSORPTION CAPABILITY QUALIFICATION TEST
E. L. Mulcahy 17 Jul. 1964 19 p refs
(Rept.-00.482)

This test program was conducted to qualify the space environment simulator cryogenic shroud heat absorption capacity to a specification of 100 kw (340,000 btu/hr) for an hour with a maximum temperature increase of 36° F. The first three test runs were performed with the system operating essentially the same as in previous unsuccessful qualification attempts. Data obtained indicated that modification recommendations by the manufacturer prior to contract termination produced little performance improvement. Examination of previous system analysis revealed a critical omission in flow analysis. This information and pressure data obtained from runs 1, 2, and 3 were used to formulate an improved operating procedure. The effectiveness of this procedure was substantiated in test runs 4 and 5. Specification compliance was demonstrated in run 6.
Author

N64-25277 Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
SELF-POWERED THERMOELECTRIC HEATER Final Report, May 28, 1962–Mar. 28, 1963
S. F. Bauer [1963] 52 p
(Contract DA-20-018-ORD-24633)
(AD-438410)

The work and results of a program to demonstrate the feasibility of a 60,000 Btu/hr multifuel self-powered heater thermoelectric generator system is given. The program includes an analytical study of the combustion–heat exchanger–thermoelectric generator design. Two pieces of hardware were built to test the results of these studies. The combustion–heat exchanger–simulated thermoelectric generator test model was built to test the thermal performance of the design. The final heater–thermoelectric generator system was built to demonstrate feasibility of self-powered operation. The feasibility model operated self-powered in the range of 115 to 133 watts output from the thermoelectric generator and at a clean ventilating heat output of 76,100 Btu/hr. The design therefore demonstrated feasibility of a self-powered heater–thermoelectric generator system.
Author

N64-25342 Harry Diamond Labs., Washington, D.C.
THERMAL RADIATION FROM HIGH-TEMPERATURE AIR
Harry J. Davis 12 May 1964 18 p refs
(TR-1225; AD-601998)

Thermal flux radiated from an isothermal slab of air is calculated, assuming one-dimensional radiation flow for a wide range of gas temperatures and densities and using the latest absorption coefficient data available. The effects of assuming an optically thin gas and different absorption coefficient data are considered. Criteria for specifying air as optically thin or optically thick are included. The energy lost from the system by radiation is compared with the total energy of the system.
Author

N64-25343 Philco Corp., Blue Bell, Pa. Research Labs.
INVESTIGATION OF THERMODYNAMIC PROPERTIES OF ROCKET COMBUSTION PRODUCTS Fifth Quarterly Technical Report, 1 Mar.–31 May 1964
D. L. Hildenbrand, L. P. Theard, and F. Ju 1 Jul. 1964 11 p refs
(Contract AF 04(611)-8523; ARPA Order 348-62)
(U-2666; RPL-TDR-64-97; AD-442335)

The purpose of this program is to provide thermodynamic data for beryllium species in cases where critical uncertainties exist. The principal effort centers on determination of the heats of formation of gaseous species in the Be-O, Be-O-H, Be-F, and Be-Cl systems. The experimental techniques and some of the results obtained are described in terms of the crystal form and thermodynamics of sublimation of $BeCl_2$, mass spectrum of $BeCl_2$ vapor, thermodynamic functions of BeF_2 (g), and the beam chopping technique.
G.D.B.

N64-25358 State U. of Iowa, Iowa City Ames Lab.
THERMAL CONTRIBUTIONS TO THE EQUATION OF STATE OF SOLIDS
C. A. Swenson Apr. 1964 31 p refs
(Contract W-7405-ENG-82)
(IS-870) OTS: $0.75

Various high pressure and atmospheric pressure data (both ultrasonic and piston-displacement) are analyzed to obtain a semiquantitative picture of the temperature-dependent lattice contributions to the equation of state of solids. Within the uncertainties of the various experiments, the isothermal bulk modulus B_T is found to be independent of temperature at constant volume for temperatures greater than the Debye temperature θ_D. This implies that the Grueneisen constant is proportional to the molar volume in this temperature region. B_T increases at constant volume as the temperature is decreased below θ_D with the magnitude of this observed increase

(about $0.01B_T$) in qualitative agreement with that estimated from the Debye model. Much greater intrinsic temperature dependences (by factors of up to 4 or 5) are found for the adiabatic bulk modulus and the shear constants. These considerations lead to a simple method for the extrapolation of room temperature pressure-volume data to low temperatures, and an application to the equation of state of indium metal is discussed. Author

N64-25394 Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.

PRESSURE AND HEAT TRANSFER MEASUREMENTS FOR MACH 8 FLOWS OVER A BLUNT PYRAMIDAL CONFIGURATION WITH AERODYNAMIC CONTROLS. PART III: HEAT TRANSFER DATA FOR DELTA WING SURFACE

Louis G. Kaufman, II Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1964 127 p refs

(Contract AF 33(616)-8130)

(FDL-TDR-64-2, Pt. III; AD-601804)

Pressure and heat-transfer data were obtained for Mach 8 flows over a blunt pyramidal configuration composed of a 70° sweepback delta wing surface and two dihedral surfaces. Trailing-edge flap deflections were varied up to 40° on all surfaces, and the model was tested with and without canards and ventral fins. The model was pitched at angles-of-attack between ±54° and was tested at sideslip angles of 0° and 12° for free-stream Reynolds numbers, based on model length, of 1.5 and 4.5 million. Author

N64-25432 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

DYNAMIC CHARACTERISTICS OF A TUBULAR HEAT EXCHANGER

A. A. Shevyakov and R. V. Yakovleva *In its* Autom. Control of Aircraft Eng. 3 Dec. 1963 p 1–17 refs (See N64-25431 17-01)

An approximate transfer function of a heat exchanger, described by a system of partial differential equations, is described. The heat flow is considered one-dimensional, and the approximate transfer function is obtained by the approximation of a partial differential equation by an ordinary differential equation with a time lag. I.v.L.

N64-25461 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A METHOD OF MEASURING TEMPERATURE WITH A PLATINUM RESISTANCE THERMOMETER

F. Z. Aliyeva 26 May 1964 4 p Transl. into ENGLISH from Soviet Patent No. 153585, 29 Jan. 1962 p 1–2

(FTD-TT-64-83/1+4; AD-601561)

The method of measuring temperature with a platinum resistance thermometer is simpler than previous methods, since in the process of temperature determination, the ratio of thermometer resistance at 100° C to its resistance at 0° is established by the calibration of the thermometer; this ratio is reduced to the standard magnitude 1.392, after which the measured temperature can be calculated from the known formula $W_t = t/100\,W_{100} + K_t$. G.D.B.

N64-25518 David Taylor Model Basin, Washington, D.C.

AN EXPERIMENTAL INVESTIGATION OF THE RELATION BETWEEN SKIN FRICTION AND HEAT TRANSFER ON THE SURFACE OF A SPHERE AT SUPERSONIC SPEEDS Part 1: Pressure Distribution and Boundary Layer Measurements on a Sphere

Richard M. Hartley, Earnest E. Harley, and Michael J. Malia, Jr. May 1964 37 p refs

(DTMB-AERO-1054; AD-602116)

In order to design a balance mechanism capable of measuring the skin-friction drag on a small surface element of a sphere subjected to supersonic flow, it was necessary to determine the order of magnitude of the skin-friction and pressure loads on such an element. To this end, wind-tunnel tests were conducted, principally at Mach 2.86, on a 3-in.-diam sphere (and hemisphere) to measure the boundary-layer characteristics at one point and to determine the pressure distribution. From these measurements, approximate maximum steady-state friction and pressure loads were determined, which will be used as starting points for the design of a skin-friction balance. Author

N64-25537 Royal Aircraft Establishment, Farnborough (Gt. Brit.)

ARC MODELS AND STEENBECK'S MINIMUM PRINCIPLE [BOGENMODELLE UND STEENBECK'SCHES MINIMUM-PRINZIP]

Th. Peters London, Min. of Aviation, Aug. 1963 16 p refs Transl. into ENGLISH from Proc. of 5th Intern. Conf. on Ionization Phenomena in Gases, Munich, v. 1 Aug.–Sep. 1961 p 885–896

(RAE-TRANS-1041)

The meaning of Steenbeck's minimum principle is discussed. If this constitutes a special case of the universal thermodynamic principle of minimum entropy production, then it does not represent an additional equation, but is implicitly included in the Elenbaas–Heller equation. A general model theory is established, showing that, from the two basic equations of arc theory, equations can be obtained in sufficient quantity to determine the model parameters. It is also shown that the channel model constitutes too rough a simplification and is therefore underdetermined. The minimum principle, however, leads to rather good results. If applied to the parabolic model, the minimum principle yields results that are already known. Author

N64-25543 European Atomic Energy Community, Brussels (Belgium)

A COMPILATION OF THE NEWEST VALUES OF THE PHYSICAL PROPERTIES OF OM_2 FOR HEAT TRANSFER PURPOSES

G. Friz, F. Reiter, and R. Nehren Joint Nucl. Res. Center, Ispra Estab. (Italy) Apr. 1964 20 p refs

(EUR-1619.E)

The paper presents the newest values of the physical properties of OM_2, compiled for heat-transfer calculations. OM_2 is an industrial mixture of terphenyl isomers. Author

N64-25551 Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

A METHOD OF COMPUTING TEMPERATURES IN MULTICOMPONENT STRUCTURES WITH TIME VARIANT BOUNDARY CONDITIONS

G. R. Guinn Apr. 1964 37 p refs

(TN-R-97)

A method of computing transient temperatures in structures is suggested for arbitrarily time-varying convective heating. Multilayered slabs are considered with a thermally thin layer at the heated face. Charts were prepared to permit the analysis of temperatures within the case-liner-propellant combination of an aerodynamically heated solid rocket. Several example problems are compared with exact solutions. Author

N64-25577 Columbia U., New York, N.Y. Institute of Flight Structures

BOUNDS FOR SOLUTIONS OF PROBLEMS IN THE THEORIES OF ELASTICITY AND HEAT CONDUCTION Final Report, 1 Oct. 1960–30 Sep. 1963

Bruno A. Boley Apr. 1964 3 p
(Grants DA-ARO(D)-31-124-61-G12; DA-ARO(D)-31-124-C140)
(AROD-2953-3; AD-440357)

The research carried out was concerned with the development of bounds for the solution of various boundary-value problems in the theories of elasticity and heat conduction for bodies of special geometries. This was done in the hope that mathematical expressions of a sufficiently simple nature may be obtained for shapes of practical interest if attention is not focused, as usual, on obtaining results of the greatest generalities. In the construction of upper bounds, use was made of the properties of the pertinent Green's function. G.D.B.

N64-25605* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
COMPARISON OF HEAT-REJECTION AND WEIGHT CHARACTERISTICS OF SEVERAL RADIATOR FIN-TUBE CONFIGURATIONS
Henry C. Haller Washington, NASA, Jul. 1964 36 p refs
(NASA-TN-D-2385) OTS: $1.00

An analytical investigation was performed to provide comparisons of heat rejection and weight capabilities of several radiator fin–tube configurations: a central fin and tube, an open-sandwich fin and tube without a fillet, two open-sandwich configurations with fillets, and a closed-sandwich fin and tube with varying sidewall thickness and vulnerable area criterion. Numerical results were obtained for the thermal characteristics of each configuration for the assumptions of isothermal tubes and constant-thickness fins that act as blackbodies radiating from both sides to a space environment at absolute zero. Author

N64-25609 Sandia Corp., Albuquerque, N. Mex.
EXPERIMENTAL INVESTIGATION OF TANTALUM OXIDATION IN SIMULATED RE-ENTRY
G. E. Clark and B. W. Marshall Jul. 1964 36 p
(SC-RR-64-575) OTS: $1.00

The tests were performed in a hyperthermal arc-powered tunnel on 36 models, half of which were exposed to one enthalpy condition and half to another. The oxygen flow in the oxygen-nitrogen mixture was varied from 0 to 21 percent in order that the effects of several different oxygen flow rates might be examined. Models exposed to pure nitrogen experienced no surface melting, whereas all the models exposed to oxygen flows, with the same enthalpy and pressure, melted. The length of time required to initiate surface melting and the rate at which the surface regressed was found to be related to oxygen flow. Surface recession under these conditions results from the formation and subsequent melting of one or more oxides, possibly tantalum pentoxide (Ta_2O_5), since measurements of the surface temperature of the models at the time of melting showed very satisfactory correlation with the melting temperature of Ta_2O_5 (1,870° C) as reported in several references. Thus, analysis of the response of tantalum under reentry conditions involves surface temperature, surface oxygen flux, and time of reentry, rather than the possibility of melting tantalum metal at 2,980° C. Author

N64-25659* Minnesota U., Minneapolis Heat Transfer Lab.
PRANDTL NUMBER MEASUREMENTS AND THERMAL CONDUCTIVITY, VISCOSITY PREDICTIONS FOR AIR, HELIUM, AND AIR-HELIUM MIXTURES
W. E. Ibele, J. L. Novotny, and E. R. G. Eckert Dec. 1963 49 p refs
(Contract NASw-3)
(NASA-CR-55273) OTS: $4.60 ph

Prandtl number measurements of air, helium, and air–helium mixtures were performed over a temperature range from 300° to 700° K. Various methods of predicting the thermal conductivity and viscosity of binary mixtures were also investigated, and results obtained by use of these methods were compared with the experimental results. The method set forth by Hirschfelder, Curtiss, and Bird using the Lennard–Jones intermolecular potential was selected, and force constants determined from experimental data were applied for predicting thermal conductivity and viscosity. Dimensionless conductivities, viscosities, and Prandtl numbers were calculated over the temperature range of 200° to 3,000° K for mixtures ranging from pure air to pure helium. Author

N64-25686 Radio Corp. of America, Lancaster, Pa. Special Electronic Components Div.
THE DEVELOPMENT OF A LOW-WORK-FUNCTION COLLECTOR FOR THERMIONIC ENERGY CONVERTERS Annual Technical Summary Report, 15 Dec. 1962–15 Dec. 1963
W. B. Hall and R. J. Hill [1963] 72 p refs
(Contract Nonr-4012(00) FBM)
(ATSR-1; AD-429503)

The construction and evaluation of a unique device for studying collectors of thermionic converters operating in the ball-of-fire mode are described. The test vehicle contains one emitter and a rotating disc on which six collectors are mounted. Without disturbing the vacuum condition, each collector may in turn be brought adjacent to the emitter, and the electrode combination can be operated as a converter. The emitter temperature, collector temperature, cesium reservoir temperature, and interelectrode spacing may all be independently varied and measured. Preliminary data for the first set of collectors evaluated in this device are presented, indicating that arc-cast tungsten produces the highest power and polycrystalline molybdenum produces the highest voltage at the highest power. Author

N64-25690* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PLANETARY ENTRY SIMULATION BY MEANS OF COMBUSTION
Richard D. Wood and R. Liaugminas (Ill. U., Urbana) Repr. from Am. Inst. of Aeron. and Astronautics, v. (CP7), Aerodynamic Testing, Mar. 1964 28 p refs Previously published as N64-17018 09-10
(Contract NAS7-100)
(NASA-CR-56461; JPL-TR-32-614)

Present-day knowledge of the atmospheres of Venus and Mars are reviewed, and the simulation of conditions by combustion-heated hypervelocity wind tunnels for the purpose of studying planetary entry are discussed. Using typical entry trajectories, expected flight conditions and aerodynamic regimes are considered, and the flow parameter requirements for ground simulation are estimated. The regions of application of the methods developed are discussed. IAA

N64-25789* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL DATA ON STAGNATION-POINT GAS INJECTION COOLING ON A HEMISPHERE-CONE IN A HYPERSONIC ARC TUNNEL
John E. Grimaud and Leonard C. Mc Ree Washington, NASA, Jul. 1964 30 p refs
(NASA-TM-X-983)

Exploratory tests were made to determine the reduction of heat transfer resulting from ejection of gases at the stagnation point on a hemisphere-cone at Mach 9 and at stagnation enthalpies up to 1,600 Btu/lb. Helium, nitrogen, and

argon gases were used as coolants. The ratio of mass flow of coolant to the mass flow of air swept out by the model projected area was less than 0.20 in all cases. The experimental heat-transfer data were normalized by the calculated stagnation-point values based on test conditions in the tunnel and are presented as a function of the surface distance from the stagnation point. The variation of shock standoff distances with mass flow and volumetric flow of the gaseous ejectants is presented along with photographs of the luminous flow field of the model during tests. Author

N64-25794 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
HIGH TEMPERATURE PHENOMENA IN HYPERSONIC FLOWS Final Report
R. J. Vidal Arnold Eng. Develop. Center Jun. 1964 55 p refs (Contract AF 40(600)-928)
(AEDC-TR-64-143)

This report summarizes the results of a program of research on high temperature phenomena in hypersonic flows. The topics included are shock tunnel studies of airflows over slender cones, theoretical and experimental investigations of nonequilibrium inviscid airflows, and studies of surface catalysis in nonequilibrium flows. The main results in each of these studies are reviewed. The details of each study are set forth in the cited references. Author

N64-25806* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-TRANSFER AND PRESSURE INVESTIGATION OF A FIN-PLATE INTERFERENCE MODEL AT A MACH NUMBER OF 6
Robert A. Jones Washington, NASA, Jul. 1964 49 p refs (NASA-TN-D-2028) OTS: $1.25

A 60° swept cylindrical-leading-edge fin mounted on a sharp flat plate was investigated at Mach 6 over a range of Reynolds numbers, based on free-stream conditions and fin leading-edge diameter, from 0.062×10^6 to 0.77×10^6. The plate was maintained at zero angle-of-attack and the yaw angle of the fin was varied from 0° to 30°. A relatively weak shock wave that originated at the leading edge of the plate impinged on the leading edge of the fin. Heat-transfer rates and pressures were measured on both the plate and the fin. The measured data on the fin and plate are compared with values calculated from laminar and turbulent theories for an infinitely long 60° swept cylinder and undisturbed plate. The results indicate that the primary effect of shock impingement and other interference was to promote transition to turbulent flow on the fin leading edge. The corresponding effect on the heat-transfer rate resulted in a range of values from approximately one to three times the calculated laminar values, depending on Reynolds number. Calculated heat-transfer rates at the stagnation line of the fin, based on the assumption of a turbulent boundary layer, were in agreement with the maximum measured values. High heat-transfer rates were also measured on the plate at locations near the impingement of the fin shock wave. In this case, the high rates occurred at all free-stream Reynolds numbers, and the maximum values were considerably above those calculated from turbulent flat-plate theory based on conditions corresponding to the measured local pressure. Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-25142* National Aeronautics and Space Administration, Washington, D.C.
METHOD FOR INVESTIGATING THRESHOLDS OF SPATIAL DISCRIMINATION BY THE HUMAN FINGERS
R. A. Kharitonov *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 83–95 (See N64-25132 17-16) OTS: $4.00

A method is proposed for investigating proprioceptive gnosis of the fingers. The full examination of one subject takes about 30 minutes. The method permits a study of the different thresholds of spatial discrimination in active touch. Investigation of the recognition of equality makes it possible to judge the relative evaluation of first and second stimuli and the phenomenon of lateralization, when the stimuli are presented to the right and left hands simultaneously or successively. Using this method, it is possible to judge the positive influence of dominance of one of the cerebral hemispheres on spatial discrimination in active touch. R.T.K.

N64-25163 Joint Publications Research Service, Washington, D.C.
FIRST GROUP FLIGHT INTO OUTER SPACE: 11–15 AUGUST 1962
29 Jun. 1964 172 p refs Transl. into ENGLISH of the Book "Pervyy Gruppovoy Kosmicheskiy Polet" Moscow, Nauka Publishing House 1964 p 1–156
(JPRS-25272; TT-64-31567) OTS: $3.00

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N64-25164 Joint Publications Research Service, Washington, D.C.
STUDIES OF THE COSMONAUTS IN THE PREFLIGHT PERIOD
In its First Group Flight into Outer Space: 11–15 Aug. 29 Jun. 1964 p 5–52 (See N64-25163 17-14) OTS: $3.00

The training of A. G. Nikolayev and P. R. Popovich for the first group space flight is discussed. The report considers this preflight period in two stages—first, increasing their body resistance to spaceflight effects, and second, giving them the background needed for scientific analysis of flight results. G.D.B.

N64-25165 Joint Publications Research Service, Washington, D.C.
CHARACTERISTICS OF FLIGHT CONDITIONS AND OF FLIGHT ASSIGNMENT
In its First Group Flight into Outer Space: 11–15 Aug. 1962 29 Jun. 1964 (See N64-25163 17-14) OTS: $3.00

This is a description of the twin space flight of Nikolayev and Popovich in Vostoks III and IV. Given are their flight assignments, conditioning of the gaseous environment, nutrition and water supply, and radiation environment. G.D.B.

N64-25166 Joint Publications Research Service, Washington, D.C.
METHODS OF PHYSIOLOGICAL INVESTIGATION AND MEDICAL CONTROL DURING THE SPACE FLIGHT
In its First Group Flight into Outer Space: 11–15 Aug. 1962 (See N64-25163 17-14) OTS: $3.00

Biotelemetric measurements during the Nikolayev–Popovich flights were conducted for research as well as for medical control of the condition of the cosmonauts. Recorded were an electrocardiogram at a single lead (thoracic bipolar), electroencephalogram at a single lead (biopolarly at the forehead–occiput region), pneumogram, electro-oculogram, electrical resistance of the skin, and signal transmission of pulse rate. G.D.B.

N64-25167 Joint Publications Research Service, Washington, D.C.
RESULTS OF FLIGHT INVESTIGATIONS
In its First Group Flight into Outer Space: 11–15 Aug. 1962 (See N64-25163 17-14) OTS: $3.00

The findings were systematized through processing and analysis in accordance with specific flight stages–prelaunch, launch into orbit, orbital, passage through the dense layers of the atmosphere, and descent. Since the conditions of both flights were identical and since the monotypical direction of changes in the main physiological reactions was identical for each astronaut, the results of processing and analyzing information obtained during the Nikolayev–Popovich flights are presented together. G.D.B.

N64-25168 Joint Publications Research Service, Washington, D.C.
POST FLIGHT EXAMINATION
In its First Group Flight into Outer Space: 11–15 Aug. 1962 29 Jun. 1964 p 110–161 (See N64-25163 17-14) OTS: $3.00

Extensive and immediate medical examinations were made of the cosmonauts Nikolayev and Popovich after their landing. The program included cardiovascular and respiratory systems, the osteosupport apparatus, neurological examination, vestibular tests, and others. Psychological effects were also noted. Their conditions were essentially unchanged. G.D.B.

N64-25608* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
COMPARISON OF GRAMMAR OF CHILDREN WITH FUNCTIONALLY DEVIANT AND NORMAL SPEECH
Paula Menyuk Repr. from J. Speech and Hearing Res., v. 7, no. 2, Jun. 1964 p 109–121 refs
(Grants NsG-496; NSF-G-16526; MH-04737-03)

A generative model of grammar was used to compare the grammar of 10 children diagnosed as using infantile speech with that of 10 matched children using normal speech to attempt to formalize the description of language simply characterized as infantile. The language of one child was periodically sampled from age two to three. A language sample from each child was analyzed, and the syntactic structures used were postulated. A number of children in each group were asked to repeat a list of sentences containing syntactic structures found in children's grammar. The term infantile seemed to be a misnomer, since at no age level did the grammatical production of a child with deviant speech match or closely match that of a child with normal speech. It was hypothesized that the differences found in the use and repetition of syntactic structures between the two groups might be due to differences in the use of the coding processes for the perception and production of language. The children with deviant speech, in the terms of the model of grammar used for analysis, formulated their sentences with the most general rules, whereas children with normal speech used increasingly differentiating rules for different structures as they matured. Author

N64-25823 Rocketdyne, Canoga Park, Calif.
ENGINEERING SAFETY INTO MISSILE-SPACE SYSTEMS
Rex B. Gordon [1964] 23 p refs Presented at the SAE-ASME-AIAA Aerospace Reliability and Maintainability Conf., Washington, 29 Jun.–1 Jul. 1964

Safety engineering, as applied to complex missile and space systems, has developed a new methodology referred to as system safety engineering. The requirement for a comprehensive approach to safety that is included as a contractually covered adjunct to the design, development, and operational phases of a systems life cycle has become apparent from costly missile mishap experience. The general concepts and accomplishments of this new engineering discipline are described along with possible beneficial relationships with reliability and other recognized organizational elements engaged in safety related activities. Author

N64-25828 Royal Air Force, Farnborough (Gt. Brit.) Inst. of Aviation Medicine
MEASURING PILOT PERFORMANCE AND CONTROL IN A FLIGHT TASK SIMULATOR
H. F. Huddleston and A. W. Napier Mar. 1964 14 p refs (IAM-TM-226)

A method of measuring control activity is described. A test pilot, a pilot, and a nonpilot were required to execute a standard run in a fixed-base flight task simulator. Traditional performance measures of error demonstrated that the test pilot achieved best accuracy, while the pilot and nonpilot produced remarkably similar satisfactory performance. One possible index of control workload and strategy demonstrated that the three individuals achieved the observed accuracy by quite dissimilar means. In particular, the nonpilot worked far harder than the pilot to achieve much the same result. Author

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-24281 Air Force Systems Command, Griffiss AFB, N.Y. Rome Air Development Center
SYMPOSIUM ON RADAR REFLECTIVITY MEASUREMENTS
Apr. 1964 557 p refs Papers Presented at Symp. Held at Lincoln Lab. (MIT), Lexington, 2–4 Jun. 1964
(RADC-TDR-64-25, Vol. I; AD-601364)

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29. POLARIZATION ASPECTS OF RADAR REFLECTIVITY MEASUREMENTS R. D. Tompkins (Naval Res. Lab., Washington, D.C.) p 365–374 refs (See N64-24309 17-08)

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30. REFLECTING PROPERTIES OF AIRCRAFT MATERIALS AT 0.6943 AND 1.06 MICRONS USING PULSED LASERS S. E. Barber (Naval Ordnance Test Station) p 375–381 refs (See N64-24310 17-08)

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32. THE SPIN-DROP METHOD OF MEASURING MODEL RADAR CROSS SECTION P. C. Fritsch (Lincoln Lab., MIT) p 400–409 (See N64-24312 17-08)

33. A METHOD OF MEASURING SMALL RADAR CROSS SECTIONS BY DIGITAL VECTOR-FIELD SUBTRACTION F. E. Heart and P. C. Fritsch (Lincoln Lab., MIT) p 410–414 (See N64-24313 17-08)

34. RADAR CROSS-SECTION MODEL FABRICATION AT CORNELL AERONAUTICAL LABORATORY J. E. Hopkins (Cornell Aeron. Lab.) p 415–418 (See N64-24314 17-08)

35. METAL-SPRAYED FIBERGLASS RADAR TARGET MODELS F. M. Hudson (Hughes Aircraft Co.) p 419–425 (See N64-24315 17-08)

36. ANTENNA SCATTERING MEASUREMENTS D. L. Moffatt (Ohio State U.) p 426–439 refs (See N64-24316 17-08)

37. THE EFFECT OF FINITE CONDUCTIVITY ON RADAR CROSS SECTIONS L. Peters, Jr. (Ohio State U.) p 440–455 refs (See N64-24317 17-08)

38. DIELECTRIC PROPERTIES: DATA AND MEASUREMENTS TECHNIQUES P. E. Rowe, E. J. Luoma, and E. F. Buckley (Emerson and Cuming, Inc.) p 456–474 refs (See N64-24318 17-25)

39. NANOSECOND PULSE SCATTERING FROM EXTENDED LABORATORY TARGETS H. S. Rothman, H. Guthart, and T. Morita (Stanford Res. Inst.) p 475–502 refs (See N64-24319 17-08)

40. SURFACE ROUGHNESS AND TOLERANCES IN MODEL SCATTERING EXPERIMENTS T. B. A. Senior (Michigan U.) p 503–520 refs (See N64-24320 17-08)

41. ESTIMATES OF THE "VOLUME" RETURN FROM STYROFOAM T. B. A. Senior and E. F. Knott (Michigan U.) p 521–526 refs (See N64-24321 17-08)

42. THE NEAR FIELD OF A STYROFOAM CYLINDER T. B. A. Senior and E. F. Knott (Michigan U.) p 527–541 (See N64-24322 17-08)

43. MODELING OF RAM-COVERED COMPLEX BODIES A. S. Thomas (A. S. Thomas, Inc.) p 542–548 refs (See N64-24323 17-08)

N64-24325 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SINGLE-BAND SHF MODULATOR AS THE LOCAL OSCILLATOR IN AN EPR SPECTROMETER

M. A. Ruban 12 May 1964 11 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 4, 1963 p 103–106

(FTD-TT-64-317/1+2+4; AD-601815)

A single-band crystal diode modulator using a slotted bridge is described in which, as a result of combined amplitude and phase modulation of SHF diode oscillations, a single-band signal power of 0.5 to 0.6 mw is obtained when 5 to 7 mw are shunted into the modulator canal. The carrier and second side frequency are suppressed not less than 50 to 55 db. Suppression of higher side frequencies is no worse than at 30 to 35 db. The described modulator is of extremely simple design and may be made very compact. The device is successfully used in place of the local oscillator in a radiospectrometer for analysis of electron–nuclear double resonance. Author

N64-24331 Harry Diamond Labs., Washington, D.C.

RANGEMETER FOR XM23 RANGEFINDER

Ira R. Marcus 17 Feb. 1964 46 p refs

(HDL-TR-1199)

The rangemeter is a digital time-interval counter that displays range when coupled to the XM23 Laser Rangefinder. It receives start and stop pulses from the rangefinder and displays range readings from 200 to 9,995 m. The total volume of the rangemeter is less than 18^3 in. The readout is made of electroluminescent material, and optical coupling is used between the computing circuits and the photoconductive readout matrix. Author

N64-24338 Grumman Aircraft Engineering Corp., Bethpage, N.Y.

DEVELOPMENT AND TESTING OF MOTION MEASURING INSTRUMENTATION FOR THE XCH-6 HYDROFOIL CRAFT

W. C. Blaiklock and E. W. Ferris Jan. 1963 40 p refs

(Contract Nonr-2695(00))

(MPD-47-135(R); AD-401111)

An instrumentation system has been developed to measure the motions in a seaway of the XCH-6 hydrofoil craft. Each parameter is detected by a transducer, and the data are transmitted to a receiving station by an FM/FM telemetry link. Data are recorded in the receiving station on magnetic tape. A test program was carried out. Machine analyses of portions of the resulting data were made to obtain frequency-amplitude spectra of pitch, roll, and heave parameters. In addition, the sea state at the craft was computed by means of analog computer operations on tail strut altitude and acceleration. It was found that distortions were introduced into the spectra by the broadband noise of the system electronics. Methods of reducing such distortion are discussed. Author

N64-24350 Space Systems Lab., Inc., Melbourne, Fla.

REAL TIME AND DAYLIGHT GEODETIC STELLAR CAMERAS Final Report

A. T. Kohn 6 Mar. 1964 179 p refs

(Contract AF 19(628)-2990)

(AFCRL-64-172; AD-602117)

An investigation is made of observation instruments that can be used as real time and daylight geodetic stellar cameras. A fixed mount, nonimage forming, externally scanning, automatic readout (FNOA) system is found to have the highest figure of merit. Characteristics of general significance are discussed in detail with emphasis on detectors exposed to ambient daylight radiation. Real time data readout is attained by coupling the photoelectric detectors with a timing system. Planes of sight are used instead of lines of sight to derive the image informations. The FNOA system is outlined in its basic concept, and a description is given of the data reduction method. The expected triangulation accuracies are derived. Author

N64-24383 Oklahoma State U., Stillwater Instrumentation Lab.

THE DETECTION OF TURBINE WHEEL TEMPERATURES BY INFRARED RADIATION INSTRUMENTATION Final Report

Paul V. Montgomery (M.S. Thesis) [1963] 109 p

(Contract AF 34(601)-14090)

(AD-426917)

The investigation definitely proved that a total radiation pyrometer can be used as a means of detecting turbine wheel temperature. Also, a magnetic amplifier system can be used to activate an alarm light or audible alarm device when the pyrometer output corresponds to a preset temperature level. All of the major instrumentation components are available commercially, and the electronic system can easily be adapted to military specifications and 400-cycle power. Author

N64-24449 Northrop Corp., Hawthorne, Calif. Norair Div.

OPTICAL PROJECTION IMAGE EVALUATION FOR TERMINAL GUIDANCE SIMULATOR STUDY PROGRAM

B. L. Cole Apr. 1964 23 p refs

(NB64-78; AD-437165)

During the image-evaluation experiment, assumptions were made concerning the value of N_e (flux response). These assumptions were that the response was limited primarily by the television section of the system as opposed to the optical projection part of the system, and that as a result of the image plane the scene could be used as the real object. Experiments were performed to validate the assumptions made in the evaluation experiments. The results of these experiments are presented. N.E.A.

N64-24511 Joint Publications Research Service, Washington, D.C.

AN INVESTIGATION ON A STRUCTURAL ANALOG OF THE STABILITY AND THE NATURE OF THE TRANSIENT PROCESS OF AN AUTOMATIC TWO-AXIS RECORDER

I. E. Ibragimov, T. M. Aliyev, A. A. Terkhachaturov, and Z. S. Marbin *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 39-47 (See N64-24506 17-09) OTS: $3.50

This paper presents the results of a study on an electronic structural analog of one of two identical measuring systems of an automatic two-axis recorder and presents the formulation of the dynamic requirements. The results of the simulation are compared with experimental data obtained in the study of several modifications of actual recorders. Author

N64-24518 Joint Publications Research Service, Washington, D.C.

ON THE THEORY OF THE SINGLE-GYROSCOPE PLATFORM

S. I. Makarikhin *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 109–119 refs (See N64-24506 17-09) OTS: $3.50

This paper investigates the behavior of the single-gyro gimbal with the objective of chasing system parameters that

will provide for gyro operation stability in the steady-stage regime. The right sides of the differential equation describing the motion of the gyroscopic system are the sum of the disturbing moments from the displacement of the center of mass of the system and its correction. The study results in the establishment of the degree of the influence of the assymetry of the characteristic of the power stabilization channel amplifier on the stability of motion of the gyro gimbal and on its drift.
Author

N64-24519 Joint Publications Research Service, Washington, D.C.
THE EFFECT OF THE RIGIDITY OF THE GYRO HOUSING AND THE ROTOR AXIS ON THE MOTION OF A GYROSCOPE
Yu. M. Kamashev *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 120–129 refs (See N64-24506 17-09) OTS: $3.50

This article considers the influence on the operation of a gyroscope with 3° of freedom by the radial stiffness of the gyro housing and determines its critical value. Author

N64-24520 Joint Publications Research Service, Washington, D.C.
ALIGNMENT OF THE GYRO-STABILIZED PLATFORM OF A HORIZONTAL INERTIAL SYSTEM
V. A. Karakashev *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 130–138 refs (See N64-24506 17-09) OTS: $3.50

This article considers the gyrocompassing theory for the automatic alignment of a three-axis gyrostabilized platform of a horizontal inertial system in the geographical coordinate system. The equations of motion of the gyrostabilized platform mounted on a fixed base and the equations for the output errors of the integrators are presented as a function of certain instrumental errors present in the system of elements. Author

N64-24521 Joint Publications Research Service, Washington, D.C.
AN ENGINEERING METHOD FOR THE SELECTION OF THE OPTIMAL PARAMETERS OF GYRODEVICES ON THE BASIS OF ECONOMIC AND TECHNOLOGICAL FACTORS
M. N. Katkhanov *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 139–150 refs (See N64-24506 17-09) OTS: $3.50

This paper is devoted to the development of an engineering method for the selection of the optimal parameters of gyroscopic instruments on the basis of economic and technological factors using the method of the Lagrange undetermined multipliers. Author

N64-24522 Joint Publications Research Service, Washington, D.C.
GRAPHICAL AND MECHANICAL METHODS FOR THE CONSTRUCTION AND RECONSTRUCTION OF AN AXONOMETRIC DRAWING IN A RECTANGULAR COORDINATE SYSTEM
G. G. Makukha *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 151–166 refs (See N64-24506 17-09) OTS: $3.50

This paper proposes a graphical method for the construction and reconstruction of an axonometric drawing in rectangular coordinates. A graphical relationship is established between the axonometric representation and the projection of an isometric drawing and is used as the basis for the kinematics of a mechanism for the mechanical drawing of the axonometric projections. A design is suggested for an isometrograph for the drawing of the rectangular isometric projections. Author

N64-24523 Joint Publications Research Service, Washington, D.C.
AN EVALUATION OF THE LINEARITY OF VIBRATING-STRING MEASURING INSTRUMENTS WITH QUADRATIC TRANSDUCERS
G. A. Kondrashkova *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 167–177 refs (See N64-24506 17-09) OTS: $3.50

This paper considers the nonlinearity of the relation of the output frequency as a function of the input measured parameters for vibrating-string measuring instruments using quadratic transducers; the magnitudes of the corrections are presented, and recommendations are given for the design of these instruments to have minimum nonlinearity. Author

N64-24545 Joint Publications Research Service, Washington, D.C.
IMPROVING THE LINEARITY OF GYROSCOPIC TACHOMETERS AND TACHOACCELEROMETERS
A. A. Odintsov *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 79–86 refs (See N64-24536 17-09) OTS: $3.50

This article is concerned with the problem of improving the linearity of the characteristic of gyroscopic tachometers by using the nonlinearity of the characteristic of the rotary transformer, which measures the angle of the instrument's rotation. The possibility of compensation is illustrated with specific examples. Author

N64-24546 Joint Publications Research Service, Washington, D.C.
METHOD OF SELECTING THE BASIC PARAMETERS OF DIRECTIONAL GYROS WITH THE AID OF NOMOGRAMS
V. P. Demidenko *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 87–98 refs (See N64-24536 17-09) OTS: $3.50

A numerical solution of differential equations of the motion of directional gyros composed by taking into account the values of the second order of smallness was carried out by a "Ural-2" electronic digital computer for various structural parameters of the gyros and different operating conditions. At this, the values of the first order of smallness included the angles and the angular velocities of the outer and inner loops (frame) of the gyro, the structural and technological errors in its production, and the angular rate of the object's motion. The volume of mathematical investigations carried out by the electronic digital computer included the following solutions: (1) abbreviated equations not taking into account the nonlinearities; (2) abbreviated equations with nonlinearities taken into account; (3) abbreviated equations taking into account various vibrating components; (4) technical equations without taking into account the nonlinearities; and (5) technical equations taking the nonlinearities into account. The nomograms plotted after the processing of the result of the first solution served as the starting nomograms for the selection of the basic parameters for the design of the gyro. Author

N64-24547 Joint Publications Research Service, Washington, D.C.
SINGLE-AXIS GYROSCOPIC STABILIZATION SYSTEMS WHICH ARE INVARIANT UNDER OUTSIDE ACTIONS
Yu. M. Khovanskiy *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 99–107 refs (See N64-24536 17-09) OTS: $3.50

One of the effective methods of improving the accuracy of operating automatic systems is to use the principle of invariance for their design. Both the structure and the parameters of

the system are so selected that the system proves to be partially or fully invariant with respect to outside actions. Under consideration in this article is a scheme for a single-axis gyrostabilizer whose sensing element is an integrating gyroscope. It takes into account the gyroscopic moment acting from the side of the gyroscope on the platform and the subsequent correcting circuit, which is introduced into the system to provide the required margin of stability. Author

N64-24548 Joint Publications Research Service, Washington, D.C.

CERTAIN PROBLEMS IN THEORY OF HORIZON GYROCOMPASSES

Ye. P. Glebov and A. A. Potapenko *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 108–122 refs (See N64-24536 17-09) OTS: $3.50

Certain problems in theory of horizon gyrocompasses are analyzed by considering the earth to have a different shape than that of sphere. Author

N64-24549 Joint Publications Research Service, Washington, D.C.

INVESTIGATION OF NONLINEAR PROPERTIES OF GYROSCOPIC SYSTEMS BY THE METHOD OF HARMONIC LINEARIZATION

S. A. Chernikov *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 123–137 refs (See N64-24536 17-09) OTS: $3.50

A method is offered for investigating gyroscopic systems by taking into account the intrinsic nonlinearities, such as dry friction and free play in the axles of the Cardan joint, free play in the reducing gear of the actuating motor, hysteresis, nonresponse, and limited power of the regulator circuit, etc. Equations reducing the linear part to a form that is convenient for an extensive use of logarithmic frequency characteristics when determining the periodic conditions, are obtained for various cases of location of the nonlinear elements in the structural scheme. The analysis of the filtering properties of the reduced linear parts serves as a basis for solving the problem by the method of harmonic linearization in investigation. Author

N64-24550 Joint Publications Research Service, Washington, D.C.

UNIT FOR INVESTIGATING THE SPECTRAL REFLECTION OF DISPERSING MATERIALS IN THE LONG-WAVE INFRARED PART OF THE SPECTRUM

M. A. Kropotkin and B. P. Kozyrev *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 138–146 refs (See N64-24536 17-09) OTS: $3.50

A description of a unit for studying the spectral coefficients of full reflection of dispersing materials in a wave range of 20μ to 400μ: the radiation is monochromatized by gratings, and the coefficients of spectral reflection are measured with the aid of a hemispheric mirror. Author

N64-24551 Joint Publications Research Service, Washington, D.C.

INTERFEROMETER FOR CONTROLLING ASPHERIC SURFACES OF ROTATION

D. T. Puryayev *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 147–152 refs (See N64-24536 17-09) OTS: $3.50

The proposed interferometer consists of these elements: (1) a monochromator; (2) a diaphragm and collimator objective; (3) a semitransparent dividing plate; (4) a plane mirror; (5) a compensation objective; (6) a controlled aspheric surface; and (7) a diaphragm and an objective. The principle governing the control of aspheric surfaces of rotation by the proposed interferometer is based on the use of a compensation objective, which is so designed and constructed that the wave front coming from it coincides with the theoretical profile of a controlled aspheric surface, or it may nearly coincide with it. I.v.L.

N64-24552 Joint Publications Research Service, Washington, D.C.

THE DYNAMIC PROPERTIES OF CERTAIN OBJECTS DURING HEAT-EXCHANGE BY CONVECTION AND CONDUCTION

N. A. Yaryshev *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 153–162 refs (See N64-24536 17-09) OTS: $3.50

In this article are investigated the dynamic properties of certain objects during a mixed (by conduction, convection, and radiation) heat exchange with a gaseous or liquid medium. Equations are derived for calculating the temperature of the principal body under different heat-exchange conditions. Author

N64-24553 Joint Publications Research Service, Washington, D.C.

RADIATION PICKUP OF TEMPERATURE ON SURFACES IN MOTION

I. I. Pekker, Ye. I. Fandeyev, and V. Ye. Shukshunov *In its* Izv. VUZov: Instr. Bldg. 14 May 1964 p 163–168 refs (See N64-24536 17-09) OTS: $3.50

A radiation pickup, which is a full-radiation pyrometer, is described. The operating sensing element of the pickup is a miniature resistance thermometer made of PEV-wire, 0.03 mm in diameter, and wound on a thin mica housing. This element is located in the focus of an aluminum parabolic mirror. Behind the sensing element is the compensation element, which is protected by a special screen from the heat radiation that falls directly upon it. Locating the sensing element and the compensation element in a row assures that each element receives the same temperature effect by the surrounding medium and, consequently, creates good temperature conditions for temperature compensation. A strong metal housing protects the mirror and the assemblies of the sensing and compensation elements against external effects. The radiation from the controlled surface falls through a window in the housing onto the mirror and is focused into the sensing element. The operating principle of this pickup, which measures the temperature of a moving surface in a temperature range from 20° to 150° C, is based on the use of the relationship existing between full energy radiated by the controlled surface and its temperature. I.v.L.

N64-24601 Joint Publictions Research Service, Washington, D.C.

RADIANT ENERGY DETECTORS

In its Infrared Equipment for Missile Homing 4 Jun. 1964 p 80–123 (See N64-24597 17-22) OTS: $3.50

The discussion of radiant energy detectors is divided as follows: (1) general considerations of the use of radiation detectors in target seekers; (2) energy levels of atoms, molecules, and crystals—the photoeffect phenomenon; (3) parameters and characteristics of radiant energy detectors; (4) types of radiant energy detectors; (5) quantum mechanics generators and amplifiers; and (6) cooling devices for radiant energy detectors. P.V.E.

N64-24602 Joint Publications Research Service, Washington, D.C.

OPTICAL SYSTEMS OF TARGET SEEKERS

In its Infrared Equipment for Missile Homing 4 Jun. 1964 OTS: $3.50

The basic characteristics of various types of optical systems used in optical target seekers are discussed. Also discussed are materials used in fabricating the optical systems and the optical filters used to keep background radiation from entering the optical system. P.V.E.

N64-24620 Beckman Instruments, Inc., Fullerton, Calif.
PRESENT AND POTENTIAL INSTRUMENTAL METHODS FOR MANNED SPACECRAFT
Walter Donner and Thomas B. Weber *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 181–199 refs Presented at Aerospace Med. Assoc. Meeting, Jun. 1963 (See N64-24606 17-16)

A number of useful instrumental methods for the continuous analysis of closed atmospheres under space-flight environments are discussed: (1) gas chromatography with its unique capability for analyzing large numbers of constituents at trace levels; (2) mass spectrometry, which lacks sufficient specificity when large numbers of trace contaminants are present, but which has the advantage of rapid scanning and is a most useful method in the area of physiological monitoring; (3) a miniature oxygen sensor method used in Project Mercury for the continuous monitoring of oxygen partial pressure; and (4) the carbon dioxide partial pressure sensor method developed for Project Mercury. Potential methods for continuous analysis include (1) nondispersed infrared analysis; (2) radiochemical exchange in which a radioactive isotope is used in the detector element and reacts with the nonradioactive sample gas; (3) the clathrate technique—another type of radiochemical analysis; (4) neutron activation; (5) thin-film sensor methods for the continuous monitoring of propellants such as *unsym*-dimethyl hydrazine and N_2O_4; and (6) a polarographic hydrogen sensor method. I.v.L.

N64-24621 Perkin-Elmer Corp., Norwalk, Conn.
OPTICAL INSTRUMENT METHODS FOR MANNED SPACECRAFT: ULTRAVIOLET, VISIBLE, INFRARED SPECTROPHOTOMETRY
Emmett S. Watson *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 201–213 (See N64-24606 17-16)

This paper reviews the basic principles of spectrophotometry to ascertain its practical applicability to spacecraft atmosphere monitoring. This is followed by a description of a specific hardware example—a miniaturized carbon dioxide sensor now under development—which is based on infrared spectrophotometry. Finally, certain lines of investigation that broaden the future practical applicability of the method are indicated. Author

N64-24622 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
BIOINSTRUMENTATION AND THE MONITORING PROBLEM
Miles Mc Lennan *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 215–222 ref (See N64-24606 17-16)

Two proposed systems of bioinstrumentation for monitoring the vital state of man in a closed ecological system are discussed. In one sytem, the bioresponses would be used for monitoring purposes. For example, the information derived from an EEG (awake, asleep, unconscious) and/or the information derived from a speech biomeasure (subjective reporting, coherency, emotional state) could be used in monitoring. In the other system, known as a viability monitor, a selected group of response items, both psychologic and physiologic, are used in a logically interrelated system. This type of arrangement provides a single output indication denoting the general vital state of the subject according to a seven-stage scale—optimum performance, marginal performance, vertigo, convulsion, sleep, unconsciousness, and death. I.v.L.

N64-24623 Naval Research Lab., Washington, D.C.
ATMOSPHERE MONITORING IN THE NUCLEAR SUBMARINE
Enoch Johnson *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 223–232 refs (See N64-24606 17-16)

Sampling by means of activated carbon has been a very fruitful source of information concerning the trace organic contaminants in nuclear submarine atmospheres. This sampling system has enabled the monitoring for total hydrocarbon content in selected submarines, and the data obtained from this monitoring are presented in tabular form. In addition, carbon sampling has provided samples for more detailed analyses, by liquid-phase chromatography, which have yielded the identification and estimation of individual hydrocarbons, as well as other organic compounds. It is indicated that major contributions to organic contamination come from solvents, such as paint thinners and mineral spirits. I.v.L.

N64-24624 Beckman Instruments, Inc., Fullerton, Calif.
ATMOSPHERE MONITORING IN THE SPACE CABIN SIMULATOR
Thomas B. Weber *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 233–255 refs (See N64-24606 17-16)

Inherent difficulties in assaying trace constituents in a space-cabin simulator include accurate collection and assay of a representative sample. Not only is it difficult to quantitatively isolate a trace constituent, but transporting and introducing it into suitable instrumentation is an intricate process. Maintaining meaningful gas standards is also difficult. Three principal steps must be followed to resolve problems concerned with closed environment atmospheres: (1) the presentation of an adequate definition of the problem; (2) the development of suitable instrumentation for the continuous monitoring of low-level constituents; and (3) the eradication and control of the undesirable contaminants. I.v.L.

N64-24625 Mine Safety Appliances Co., Pittsburgh, Pa.
EQUIPMENT FOR ALARM SYSTEMS
John P. Strange *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 257–267 refs (See N64-24606 17-16)

Proposed alarm systems for monitoring the air for toxic compounds in a closed ecological system must include the following equipment: (1) sensors suitable for long periods of continuous operation with multiple purpose if possible; (2) a data analysis apparatus that can assay the signals from a number of sensors to minimize the equipment needed, and (3) devices that can appraise the seriousness of a hazardous condition and actuate alarms that are visible, audible, or associated with feeling. In addition, simple backup equipment should be available with which personnel can obtain additional data on the presence and concentration of a larger number of compounds for which it is impractical to monitor the air continuously. I.v.L.

N64-24788* National Aeronautics and Space Administration, Washington, D.C.
AN ACTINOMETRIC STATION COMPOSED OF ABSOLUTE INSTRUMENTS
L. V. Gul'nitskiy and I. I. Maslennikov *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 15–23 refs (See N64-24786 17-21) OTS: $2.75

Many years of research into the problem of improving the methods of actinometric observation and devising a common actinometric scale, coupled with experience in the design of a series of actinometric instruments, have led to the construction of an actinometric station composed of 36 absolute instruments, operated by a team of scientists who designed, built, and tested these instruments. Some of these instruments are pyrhelio-pyrgeometer, compensation pyrgeometer, effective pyranometer, balance indicator, and compensation pyranometer. G.D.B.

N64-24861 RCA Service Co., Inc., Patrick AFB, Fla.
SOME TRENDS IN ADVANCED RANGE INSTRUMENTATION
L. E. Mertens *In* RCA, Camden, N.J. Systems Eng. and Space Technol. [1964] p 52–55 refs (See N64-24851 17-01)

Recent trends in metric accuracy requirements, systems configuration, propagation limitations, survey accuracy, error adjustment, system control, and calibration are briefly examined in this paper. G.D.B.

N64-24925 Aeronautical Research Council (Gt. Brit.)
INFLATABLE SERVO ACTUATORS Current Paper
A. R. Mettam London, HMSO, 1964 26 p refs
(ARC-CP-671; Supersedes RAE-AERO-2840; ARC-24445)
HMSO: 5s 6d

The force vs pressure relationship of nose fluid pressure servoactuators would be greatly improved if the whole wall surface of the working chamber were employed in energy transfer, instead of only the small area of a piston or vane. Some ways of achieving this, by the inflation to cylindrical form of flat envelopes of flexible material, were investigated during development of an artificial muscle system. This note records the performance of various prototype actuators and discusses possible applications. These actuators are discussed mainly in a general engineering context, but some comments are included relative to the medical applications for which they were developed. Simple design formulas for muscle-motor actuators are presented. Author

N64-24948 Bell Helicopter Co., Fort Worth, Tex.
ALTIMETER DISPLAY STUDY. PART II: SUMMARY OF EXPERIMENTAL TESTING Final Report, May 1960–Jan. 1962
C. B. Elam, W. G. Matheny, and D. A. Schum Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1964 188 p refs
(Contract AF 33(616)-8236)
(ASD-TDR-63-623, Pt. III)

Results of five altimeter display studies (four by static presentation and one by cinematic presentation) are described. The five altimeter display designs evaluated were the three-pointer (MA-1), the horizontal drum pointer, the single-tape instrument. Methods of evaluation were varied extensively. Measurements of errors and response time were taken for all studies. Results were generally in agreement that the following order of goodness prevails—single-tape pointer, horizontal drum pointer, vertical drum pointer (MD-1), and three pointer (MA-1). The dual-tape design appears inferior to the MD-1 with respect to errors, but is superior with respect to response time. Author

N64-24981* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AN INTEGRATING SPHERE REFLECTOMETER FOR THE DETERMINATION OF ABSOLUTE HEMISPHERICAL SPECTRAL REFLECTANCE
Gene A. Zerlaut (IIT Res. Inst.) and A. C. Krupnick N.Y., AIAA [1964] 12 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(AIAA Paper-64-255) AIAA: $0.50 members, $1.00 nonmembers

This paper describes an instrument for the measurement of the absolute hemispherical spectral reflectance of surfaces. The instrument possesses the dual ability to measure and monitor the absolute reflectance of a magnesium oxide (or other) standard and to compare this reflectance to that of any other surface. The theory is a modification of the analyses of Preston, and Middleton and Sanders. The major error in their absolute methods may be the inability to insure that the magnesium oxide standard and the magnesium oxide smoked sphere wall possess exactly the same reflectance. This error has been essentially eliminated by designing the integrating sphere so that the reflectance of the sphere wall can be measured in terms of the standard, or conversely. The determination of the absolute reflectance of the standard can then be done by one of two methods: (1) smoking either or both the standard and sphere until their reflectances are exactly equal; or (2) substituting the ratio of their reflectances into a rather ponderous algebraic expression. Author

N64-25171 Hughes Aircraft Co., Culver City, Calif.
DEVELOPMENT AND FABRICATION OF AN ADVANCED COMPONENT AND SYSTEM TEST TABLE AND ITS ASSOCIATED ELECTRONICS (M-1 MASTER TEST STATION) Monthly Progress Report, 30 Dec. 1963–26 Jan. 1964
L. R. Stumpf et al 13 Feb. 1964 10 p
(Contract AF 29(600)-3069)
(Rept.-64H-0964/8070; MPR-30; AD-601261)

The general technical status, accomplishments during the period, and problem areas in the development and fabrication of an advanced component and system test table, including the MIDARM system and gyrocontrolled mode, are described. G.D.B.

N64-25199 National Research Council of Canada, Ottawa Low Temperature Lab.
A LOW TEMPERATURE CENTRIFUGAL COMPRESSOR TEST RIG Mechanical Engineering Report
C. K. Rush Nov. 1963 57 p refs
(MD-48; NRC-7776)

An examination of the requirements for dynamic similarity in centrifugal compressors demonstrates the possible advantages of using air at temperatures down to 100° K. A test rig capable of operating at low temperature is described. Test results for inlet conditions, ranging from room temperature to 125° K are presented. The predicted advantages of operating at low temperature are confirmed. However, the desired result that the performance should be identical at four different conditions of dynamic similarity was not achieved, although the differences are relatively small. Further examination of the results suggests that the differences are due to changes in geometry with changes in the test rig internal pressure. Author

N64-25227 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
PRESSURE CALIBRATION OF THE GOETZ AEROSOL SPECTROMETER
Hermann E. Gerber Apr. 1964 34 p refs
(USAELRDL-TR-2456; AD-602142)

This report discusses and determines the pressure dependence of the operating characteristics of the Goetz aerosol

spectrometer. Since the fallout of particles in the Goetz centrifuge depends on the mean free paths of the air molecules, the deposition characteristics of the aerosol particles (according to the Cunningham correction to the Stokes Law) become a function of air density or pressure. Calibration runs were conducted with monodisperse latex particles of various sizes in a pressure chamber simulating various atmospheric altitudes. The deposition lengths for aerosol particles of a given size decrease with decreasing pressure. The smaller the aerosol particles, the greater is the pressure dependence on the particle deposition. Correction factors could be determined for various particle sizes in atmospheric pressure. Some examples of application of these pressure calibrations to field measurements are presented. Author

N64-25232 Technical Operations Research, Burlington, Mass.
CONTACT PRINTING WITH COHERENT LIGHT Final Report
H. Heckscher and B. J. Thompson Griffiss AFB, N.Y., RADC, May 1964 50 p refs
(Contract AF 30(602)-3139)
(RADC-TDR-64-120; AD-602246)

The high degree of collimation and the high energy densities that can be simultaneously obtained from the output of a laser made it an attractive proposition as a light source in contract printers. However, special problems do arise in such a system mainly from the high degree of spatial and time coherence of the laser output. These properties cause deleterious interference and diffraction effects in many printing systems. Experiments are described using an He-Ne gas laser as a light source associated with standard printing frames and continuous drum printers. The troublesome effects, particularly the interference fringes, are illustrated, and a method is shown for eliminating these effects through the introduction of a suitable liquid between the emulsions. Recommendations are made for a feasibility study with improved optical equipment to obtain high resolution, experimenting with Kalvar and diazo-type materials using the nitrogen gas laser as a source, experimenting with the diazo-type material recently sensitized in the green region of the visible spectrum, and more intensive study of the effect of coherence upon exposure. Author

N64-25243 Southern Research Inst., Birmingham, Ala.
DEVELOPMENT OF A HYPERVELOCITY IMPACT DATA RECORDER Technical Documentary Report, 31 May 1960–31 Oct. 1963
J. R. Cooper, J. E. Horn, and A. L. Thomas, Jr. Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, May 1964 143 p refs
(Contract AF 08(635)-1315)
(Rept.-4728-1200-VI; AEDC-TDR-64-118; AD-600891)

Methods of recording 14 or more X-ray or gamma ray shadowgrams of a single hypervelocity impact event were studied. Desired exposure times were as short as 0.02 μsec. The power and pulse length limitations of a commercially available flash X-ray tube were experimentally determined, and recommendations for extending the pulse length are presented. Two radioactive isotope sources, Co^{60} and Cs^{137}, were studied and found to be impractical because of the excessive intensity levels required. Breadboard models of two detection and recording systems employing scintillator arrays and screens as detectors, and image intensifiers as shutters and light amplifiers were built and evaluated. Author

N64-25268 Harry Diamond Labs., Washington, D.C.
ACOUSTIC CONTROL OF PNEUMATIC DIGITAL AMPLIFIERS
Richard N. Gottron *In its* Proc. of the Fluid Amplification Symp., Vol. 1 May 1964 p 279–292 refs (See N64-25253 17-11)

The effect of audiofrequency acoustic waves on a pneumatic digital unit is considered. Experimental evidence is presented to show that digital units can be switched with less acoustic power than pneumatic power. The use of mixing to reduce high-frequency information to a usable range is discussed, and experimental evidence is presented. Author

N64-25359 Minneapolis-Honeywell Regulator Co., Minn. Aeronautical Div.
ELECTROSTATIC GYRO EVALUATION PROGRAM. PHASE II. DEVELOPMENT OF ESG TEST EQUIPMENT Final Report
F. A. Andrews, M. H. Riesgraf, T. N. Berlage, A. Shalloway, C. Bare et al Wright Patterson AFB, Ohio, Navigation and Guidance Lab., Jan. 1964 165 p
(Contract AF 33(616)-8350)
(MH-2941-FRI; AD-437927)

The purpose of this project was to develop, procure, fabricate, and checkout test equipment required for the evaluation of electrically suspended gyros in the gimbaled and strapdown modes. This report describes the test equipment developed and procured, and sets forth methods for its installation, calibration, and operation. Author

N64-25363 European Atomic Energy Community, Brussels, (Belgium)
CALIBRATION LOOP OF HIGH PRECISION FOR MAGNETIC FLOWMETER [EICHUNG MAGNETISCHER DURCHFLUSSMESSER FUR FLUSSIGMETALLE]
B. Schelten-Peterssen and W. Schulze Joint Nucl. Res. Center, Ispra Estab. (Italy) Apr. 1964 39 p refs In GERMAN; ENGLISH Summary Availiable from Belgian Am. Bank and Trust Co., N.Y. Account no. 121.86: 60 Belg. Fr.
(DUR-1631.D)

A calibration loop of high precision for magnetic flowmeter is described. Medium errors are less than 1%. A theoretical method for calculating the mass flow and all results obtained using this loop are described. Author

N64-25388 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELEMENTS OF METROLOGY
In its Testing Air-Breathing Engines, 28 Jan. 1964 p 13–34 (See N64-25386 17-27)

This is a review of Soviet standards, measures, and measurements, and how they are used to control instruments of measurement in factories and research institutions. The methods of checking measures and measurement instruments in the U.S.S.R. are discussed. All measures and measurement instruments are divided into two groups—standard and working. Direct and indirect measurements are also described. G.D.B.

N64-25389 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MEASUREMENT INSTRUMENTS AND DEVICES
In its Testing Air-Breathing Engines, 28 Jan. 1964 p 35–138 (See N64-25386 17-27)

This paper examines the parameters that characterize the operation of a ramjet engine, and describes instruments and measuring devices widely used in laboratory and test-station practice. Measurement of pressure with liquid manometers and spring manometers is discussed; measurement of temperatures is described. G.D.B.

N64-25445 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AN APPARATUS FOR MEASURING RAPIDLY CHANGING TEMPERATURES

G. Ye. London 26 May 1964 4 p Transl. into ENGLISH from Soviet Patent no. 153586, 12 May 1962 p 1–2
(FTD-TT-64-82-/1+2+4; AD-601508)

The apparatus for measuring rapidly changing temperatures consists of an inertia thermotransducer, a lead network, and differentiating operational amplifiers. The amplifiers include a calculating device to determine the time constant of the thermotransducer. To automatically correct the lead-network time constant, a magnetizing coil, through which pass currents proportional to the thermotransducer time constant, is used in the lead network. G.D.B.

N64-25446 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AN APPARATUS FOR SOLDERING GAS TURBINE BLADES
I. K. Sklyarov, Yu. I. Bereznikov, N. N. Sirchenko, A. A. Alyamskaya, and L. S. Surikov 26 May 1964 5 p Transl. into ENGLISH from Soviet Patent no. 118470, 17 Dec. 1955 p 1–2
(FTD-TT-64-142/1+2+4; AD-601562)

The apparatus for soldering gas turbine blades with cooling channels formed between the blade body and a thin-walled shell, and by using heat-resistant solders in a reductive gas medium or a vacuum is superior to previous types. Its advantage is that it uniformly compresses the shell to the blade body in the process of soldering; the blade is placed in a container with a pocket formed by thin walls adjacent to the blade surface and compressed by excess pressure outside the pocket or by a vacuum within it. G.D.B.

N64-25478 Air Force Cambridge Research Labs., Bedford, Mass.
AN APPLICATION OF INDUCTION HEATING TO ROCK DEFORMATION APPARATUS
R. E. Riecker Mar. 1964 20 p *Its* Instrumentation Papers No. 36
(AFCRL-64-215; AD-601167)

High-frequency induction provides the advantages of concentrated, controlled, and instantaneous heating of samples in rock deformation experiments; the attendant disadvantages are high initial cost, bulky support equipment, and an inability to use standard temperature-monitoring equipment. A new shear press capable of simultaneously applying pressures of 50 kb and temperatures of 1,000° C to thin sample pellets 1/4 in. to 1 in. in diameter uses a 5-kw, 450-kc induction heater, a Speedomax H recorder, a current-adjusting-type control unit, a saturable-core reactor, a magnetic amplifier, and an infrared pyrometer to accurately record, control, and monitor sample temperatures within 1% from 200° to 1,000° C. Less than 45 sec is required for the apparatus to reach thermal equilibrium at maximum temperature. Author

N64-25496 Aeronautical Research Council (Gt. Brit.)
KINEMATIC RECTIFICATION IN DAMPED SINGLE-AXIS GYROS
R. R. Allan London, HMSO, 1964 17 p refs
(ARC-R&M-3358; Supersedes RAE-TN-SPACE-14, ARC-24450) HMSO: 7s

In a single-axis gyro a rotation about the input axis forces the spin axis to rotate about the output axis. The true input axis is oscillating about its nominal position, and the gyro "sees" a varying component of the angular velocity about the nominal spin axis. This may be rectified, thereby causing a drift, if the components of angular velocity along the input and spin axes are correlated. The drift rate is evaluated in terms of the components of angular velocity affecting the gyro. Author

N64-25548 Brookhaven National Lab., Upton, N.Y.
HIGH RESOLUTION AT LOW ENERGIES WITH AN IRON DOUBLE-FOCUSING BETA-RAY SPECTROMETER
I. Bergstrom, Y. Y. Cao, and G. T. Emery Mar. 1964 6 p refs
(BNL-850(T-336)) OTS: $0.50

Perlman and McKeown found that the resolution of an iron double-focusing spectrometer could be improved by a factor of 4 by adding shims of soft iron around the outside of the spectrometer; this was accomplished to optimize the resolution for a conversion line of 624 Kev (C_s^{137} K662). It was not clear whether this shimming was then also optimum for lines of other energies; differences might be expected in the low-energy region, where remanence effects and effects of the earth's field may be significant. The availability of an electromagnetically separated source of Kr^{79} allowed the investigation reported in this paper to be made. In the decay of Kr^{79}, there is a 44 Kev transition in Br^{79}, with a K-conversion line at 31 Kev, and there are KLL Auger electrons at around 10 Kev. G.D.B.

N64-25596 Naval Research Lab., Washington, D.C. Applications Research Div.
A COMPARISON OF FOUR TYPES OF ALTIMETERS. PHASE I: TRACKING A COMMAND PROFILE. PHASE II: READING PRESET ALTITUDES Interim Report
R. E. Reilly, P. N. Ziegler, J. H. Hill, and R. Chernikoff Apr. 1964 13 p
(NRL-Memo-1522; AD-601000)

A two-phase experiment was carried out comparing four altimeters: counter pointer (CP), counter drum pointer (CDP), drum pointer (DP), and three pointer (3P). One phase measured accuracy of altitude control. During this phase, the operator simultaneously performed a secondary two-dimensional tracking task. The second phase measured speed and accuracy of reading random altitude presentations. Using five naval enlisted men as subjects, tracking performance was found to be best for CP and CDP, followed by DP, with 3P the poorest of the four altimeters. The results for reading accuracy in both phases showed CP to be best, followed by CDP, DP, and 3P, in that order. Author

N64-25601* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MINIGUIDE — A SIMPLIFIED ATTITUDE CONTROL FOR SPIN-STABILIZED VEHICLES
Henry J. E. Reid Jr. and A. Douglas Garner Repr. from J. of Spacecraft and Rockets, v. 1, no. 3 May–Jun. 1964 p 342-344 Presented at the AIAA Summer Meeting, Los Angeles, 17–20 Jun. 1963
(NASA-RP-230)

A description is given of the simple control theory for a pitch-attitude and a vertical-attitude control scheme. The vertical control uses a horizon detecting telescope with a field of view several degrees wide. This telescope is set at an angle with respect to the spin axis, which (when the axis is vertical and the vehicle is at the correct altitude) allows the field of view to sweep around the edge of the apparent earth disk. In this condition, the portion of the field of view occupied by earth remains the same throughout the revolution of the vehicle. If the spin axis of the vehicle is not vertical, the portion of the field of view occupied by earth will change as the vehicle spins. The horizontal version of the pitch control uses two body-fixed horizon detectors with narrow fields of view mounted on opposite sides of the vehicle spin axis. A successful flight test of the pitch-control scheme is described, and two applications are considered. IAA

N64-25621 Naval Research Lab., Washington, D.C.
AN X-RAY FLUORESCENCE CAMERA
A. J. Pollard 20 Mar. 1964 7 p
(NRL-6061; AD-438037) OTS: $0.50

An X-ray fluorescence camera has been designed as a companion piece to the X-ray powder-diffraction camera. It is possible with this device to detect elements with an atomic number of 19 (potassium) and above. Quantitative determinations may be made using film-transmittance measurements similar to those used in quantitative analysis by powder techniques. The camera case has been constructed in such a way that it can be evacuated. A mechanism has been included that permits the examination of specimens just large enough to give ordinary powder patterns on film. Author

N64-25626* Texas U., Austin Electrical Engineering Research Lab.
GERMANIUM BOLOMETER DETECTOR OF MILLIMETER WAVELENGTH THERMAL ENERGY
D. G. Galloway and C. W. Tolbert Repr. from the Rev. of Sci. Instr., v. 35, no. 5, May 1964 p 628–630 refs
(Grant NsG-432)

This paper describes the construction and evaluation of a K_a-band bolometer receiver using a highly temperature-resistance dependent (at 4.2° K) doped germanium bolometer. The receiver noise equivalent power (NEP) of approximately 10^{-9}W and input bandwidth exceeding 12 Gc has an rms signal level indicating uncertainty equivalent to 90C° per cycle of output filtering. Evaluation of the germanium bolometer as a millimeter wavelength radiometer detector was performed at K_a band to utillize existing apparatus and to facilitate fabrication of the receiver. With the increased sensitivity anticipated for smaller bolometer elements, short millimeter and submilimeter wavelength scaled models of the receiver appear promising as detectors for radio telescopes. Author

N64-25638 Radio Corp. of America, Bethesda, Md. Data Systems Center
DETERMINATION OF PARAMETERS FOR RADIOLOGICAL PREDICTION AND MONITORING SYSTEMS
P. Reimers, C. Diehm, B. Holz, H. Kurkjian, R. Krumm et al Jun. 1963 207 p refs
(Contract OCD-OS-62-140)
(AD-412431)

Design concepts and parameters are presented for two radiological monitoring systems; a shelter-based system, and an automatic system. Gamma radiation intensities up to 1,000 r/hr are to be monitored. Recommended spacing of sensors is based on computer simulation of accuracies obtainable with various sensor spacings. Various combinations of instrument error, fallout pattern, probability of instrument malfunction, and orientations of the sensor network were used in these simulations. Initial costs and annual operating costs are estimated. Author

N64-25669 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)
AN ELECTRON GUN FOR VAPORIZING MATERIAL AT A HIGH MELTING POINT [UN CANNONE ELETTRONICO PER L'EVAPORAZIONE DI MATERIALI AD ALTO PUNTO DI FUSIONE]
G. Sacerdoti, S. Cappannini, and G. Pasotti 7 Apr. 1964 19 p refs in ITALIAN
(LNF-64/9)

The use of an electron gun for the production of thin films, and the principles of the annular and "Pierce" electron guns are described. Experimental results for the vaporization of pure niobium and vanadium are tabulated for parameters that include electron beam power; vacuum, vaporization, and deposition rates; source temperature; and barometric pressure. Trans. by P.F.E.

N64-25688* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A NORMAL-INCIDENCE REFLECTIVE POLARISCOPE FOR VISCOELASTICITY MEASUREMENTS
Anthony San Miguel and Robert H. Silver 1 Jun. 1964 20 p refs
(NASA-CR-56516; JPL-TR-32-573) OTS: $1.60 ph

A normal-incidence reflective polariscope, together with some auxiliary instrumentation, is described. The instrument consists of eight unit polariscopes, suitably oriented, that are indexed into position within a short period of time to obtain a set of eight data. The data obtained provide sufficient information to separate the principal strains obtained at different time intervals. The primary experimental objective was to design an inflated cylinder test, analogous to the loading experienced in a solid-propellant rocket, that would enable reasonable measurements of the triaxial surface-layer strains of a viscoelastic material as a function of time. The stress geometry imposed on the viscoelastic material was that of an unrestricted, internally pressurized, thick-walled tubular cylinder. The material investigated was polyurethane solid propellant. Two different methods to reduce the biaxial strains in a low-modulus birefringent polyurethane coating are also described. Author

N64-25710* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SOLID STATE SATELLITE SEPARATION SEQUENCE TIMER
Justin C. Schaffert and Thomas D. Clem Washington, NASA, Jul. 1964 13 p
(NASA-TN-D-2319) OTS: $0.50

A solid-state satellite separation sequence timer is described, which is designed to provide for the payload separation sequence at appropriate intervals. Two methods of firing explosive charges are discussed. The versatility of a solid-state system is noted, as well as its qualification for adverse environments. Examples of the systems used in the UK-1/S-51 (Ariel I) and UK-2/S-52 satellites are given. Author

N64-25750 General Electric Co., Philadelphia, Pa.
SKYBOLT INTEGRATING ACCELEROMETER Final Status Report
W. Nicolini 21 Mar. 1963 47 p
(Contract AF 33(600)-39587)
(Rept.-63SD543; AD-400106)

The Skybolt integrating accelerometer as presently designed is an open loop eddy current type of instrument. Its advantages are that no power input is required except for readout excitation and temperature control during the carry phase, radiation, or any other known countermeasures that have no significant effect on instrument performance as compared to devices containing semiconductors, and the simple mechanical system assures extremely high reliability. General description, design considerations, development testing, and production status are all included in this report. G.D.B.

N64-25770* ARA, Inc., West Covina, Calif.
CONCEPTS OF MULTIPLE-IMPACT STUDY OF ENERGY ABSORPTION Second Quarterly Progress Report, 1 Jul.–1 Oct. 1963

David L. Platus, Patrick J. Cunningham, Frank A. Marovich, and Holland H. Freeman 14 Oct. 1963 42 p refs
(Contract NAS7-226)
(NASA-CR-56445; Rept.-26) OTS: $4.60 ph

Cyclic torsional testing apparatus for studying materials in relation to cyclic strain energy impact devices is described. The apparatus provides cyclic stress–strain curves for materials under conditions representative of those occurring under impact cycling conditions. Calibration procedures and data reduction methods are described, and the results of preliminary runs on aluminum are presented. The results of a brief study of cyclic strain energy devices in relation to crew protection applications are presented, and several key problem areas are identified. The design of a torus impact device, applicable to crew protection systems, is described. Author

N64-25830 Minneapolis-Honeywell Regulator Co., Minn.
AN AUTOMATIC FROST-POINT HYGROMETER USING RADIOACTIVE DETECTION
J. G. Ballinger 12 Sep. 1963 37 p refs
(R-RD-6300)

This paper describes a new type of automatic frost-point hygrometer for measurement of the stratospheric distribution of water vapor. The frost deposit is detected directly by energy attenuation of alpha radiation. An automatic control maintains a constant mass deposit of frost on a cooled surface by controlling the direction of current flow through a thermoelectric cooler. Advantages of this sensing technique over the usual optical method are indicated. Instruments suitable for balloon flights are described, and the results of several flights are discussed. Author

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-24324 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELECTRONIC DIFFERENTIATING DEVICES FOR ANALYSIS OF PHYSIOLOGICAL PROCESSES
Ye. B. Babskiy, V. L. Karpman, G. M. Petrov, and A. I. Skachkova 23 Mar. 1964 12 p Transl. into ENGLISH from Elektron v Med. (Moscow), 1960 p 74–78
(FTD-TT-63-1191/1+2+4; AD-437118)

Electronic devices performing mathematical integration and differentiation have, in recent years, begun to find application in physiology. Thus, integrators are being successfully used in electroencephalographic and electromyographic studies. Electronic differentiating devices for studying cyclic physiological processes make it possible to record both the process under study and its derivatives. The first derivative characterizes the rate of change of the given process, and the second derivative yields its acceleration. Thus, it is possible to obtain data needed for a more complete analysis of the phenomenon under study. A method of study such as this is of significant value in the solution of many questions in the physiology of the motor apparatus and the physiology of blood circulation. J.L.D.

N64-24339 Pennsylvania U., Philadelphia Graduate School of Medicine
HUMAN MECHANICS Four Monographs Abridged
Wilton Marion Krogman and Francis E. Johnston Wright-Patterson AFB, Ohio, AMRL, Dec. 1963 388 p refs
(Contract AF 33(616)-8091)
(AMRL-TDR-63-123; AD-600619)

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3. THE HUMAN MOTOR J. Amar p 154–214 (See N64-24342 17-16)
4. SPACE REQUIREMENTS OF THE SEATED OPERATOR W. T. Dempster p 214–340 refs (See N64-24343 17-16)

N64-24340 Pennsylvania U., Philadelphia Graduate School of Medicine
THE CENTER OF GRAVITY OF THE HUMAN BODY
W. Braune and O. Fischer *In its* Human Mech. Dec. 1963 p 1–57 (See N64-24339 17-16)

Four cadavers were used to study the location of the center of gravity in the human body. The information gained from the cadavers was used in determining the following: (1) the common center of gravity for the entire body, and for whole sections, from the centers of gravity and weights of separate limbs; (2) the location of the center of gravity on the living human body in different positions and with different loads; (3) the importance of the relations of the location of the gravity line to the supporting surface; (4) the effect of the pliability of the torso on the location of the common center of gravity; and (5) the effect of ground slope on the position of the body. P.V.E.

N64-24341 Pennsylvania U., Philadelphia Graduate School of Medicine
THEORETICAL FUNDAMENTALS FOR A MECHANICS OF LIVING BODIES
O. Fischer *In its* Human Mech. Dec. 1963 p 58–153 (See N64-24339 17-16)

The kinetics of joint systems and the state of motion and equilibrium in man are investigated. Mass systems and fixed points within the individual limbs (main points of the body parts), which are similar to the center of gravity in the kinetics of a single rigid body, are introduced. P.V.E.

N64-24342 Pennsylvania U., Philadelphia Graduate School of Medicine
THE HUMAN MOTOR
J. Amar *In its* Human Mech. Dec. 1963 p 154–214 (See N64-24339 17-16)

The following are discussed with respect to the motor activities of the human body: (1) the general principles of mechanics; (2) the human machine; (3) human energy; (4) man and his environment; (5) experimental methods; and (6) industrial labor. P.V.E.

N64-24343 Pennsylvania U., Philadelphia Graduate School of Medicine
SPACE REQUIREMENTS OF THE SEATED OPERATOR
W. T. Dempster *In its* Human Mech. Dec. 1963 p 215–340 refs (See N64-24339 17-16)

Kinematic and mechanical information obtained in studying the human body is discussed with respect to the work space required by a seated person performing various body movements. The study was concerned with synthesizing realistic manikins, understanding the body kinematics of a seated

operator in his work space, and defining the dimensions of the work space. P.V.E.

N64-24487 Joint Publications Research Service, Washington, D.C.

THE STABILITY OF FUNCTIONALLY HETEROGENOUS PORTIONS OF DNA TO IONIZING RADIATIONS

G. Ye. Fradkin 29 Jun. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 2, 1964 p 457–460

(JPRS-25282; TT-64-31575)

Reported are the results of a study of the sensitivity of the structural (genetic code, programing protein synthesis) and the regulating mechanism of the DNA of the moderate phagus λ to radiation. The indicator of radiosensitivity of the regulating mechanism was the destruction of the function of the operator chromosome segment, characterized by the appearance of virulent mutants of the moderate phagus λ. N.E.A.

N64-24561 Joint Publications Research Service, Washington, D.C.

MEDICAL AND BIOCHEMICAL INVESTIGATIONS

28 May 1964 18 p refs Transl. into ENGLISH of 2 Articles from Voprosy Med. Khim. (Moscow), v. 10, no. 1, 1964 p 12–15, 77–80

(JPRS-24838; OTS-64-31365) OTS: $0.50

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2. STUDIES OF COMBINATION SPECTRA DISPERSION IN CATECHOLAMINES V. V. Menshikov and A. D. Yesikov p 10–15 refs (See N64-24563 17-16)

N64-24562 Joint Publications Research Service, Washington, D.C.

INCREASE OF SOME BLOOD SERUM ENZYME ACTIVITY DUE TO STRONG STIMULI

A. F. Blyuger, M. L. Belen'kiy, and Ya. Ya. Shuster *In its* Med. and Biochem. Invest. 28 May 1964 p 1–9 refs (See N64-24561 17-16) OTS: $0.50

Experiments were performed to study the activity of several enzymes influenced by strong stimuli. It was shown that under the action of strong stimuli (hypoxia, hypothermia, asphyxia, shock in burns, spasms, nonspecific inflammation, and septicemia caused by *E. coli*), changes in the activity of glutamic–pyroracemic transaminase, glutamic–oxalacetic transaminase, and aldolase took place in the blood serum and tissue. The majority of the stimuli caused an increase of enzyme activity in the serum and tissues. Conditions that permitted the development of acidosis prevented the activity of blood-serum enzymes under the action of strong stimuli. No direct correlation is observed between the increase of serum enzyme activity and tissue enzyme activity. N.E.A.

N64-24563 Joint Publications Research Service, Washington, D.C.

STUDIES OF COMBINATION SPECTRA DISPERSION IN SPECTROFLUOROMETRIC ESTIMATION OF CATECHOLAMINES

V. V. Menshikov and A. D. Yesikov *In its* Med. and Biochem. Invest. 28 May 1964 p 10–15 refs (See N64-24561 17-16) OTS: $0.50

A photoelectronic unit is described for investigating the combination spectra dispersion. It consists of the ISP-51 spectrograph with a photoelectric adapter (FEP-1) and of a unit for analyzing the combination spectra dispersion. The spectra of fluorescence for adrenolutin and noradrenalin, obtained by the oxidation of a base of adrenalin and noradrenaline bitartrate, turned out to be identical to the spectra of fluorescence of urine extracts treated by the same method. The method of spectrofluorometry makes possible the differentiation of the fluorescence of catecholamines from the fluorescence of medicines (quinidine and tetracycline). N.E.A.

N64-24606 Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.

A SYMPOSIUM ON TOXICITY IN THE CLOSED ECOLOGICAL SYSTEM

M. Honma and H. J. Crosby, ed. [1963] 325 p refs Symp. held 29–31 Jul. 1963, Palo Alto, Calif.; Sponsored by Navy and Lockheed

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N64-24607 Navy Dept., Washington, D.C.
ORIGIN OF CONTAMINATION IN THE NUCLEAR SUBMARINE ATMOSPHERE
Jack L. Kinsey *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 1–8 (See N64-24606 17-16)

The sources of atmospheric contamination and the methods currently used to overcome them in nuclear submarines are discussed. The contaminants discussed include carbon dioxide, carbon monoxide, hydrocarbons, phosphate-ester hydraulic fluids, aerosols, and air ions. M.P.G.

N64-24608 Naval Research Lab., Washington, D.C.
EVOLUTION OF MATERIALS IN THE CLOSED SYSTEM
W. L. Anderson and R. A. Saunders *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 9–18 (See N64-24606 17-16)

The results of analyses of nuclear submarine and spacecraft atmospheres conducted during actual manned operations are discussed. The trace contaminants that have been identified are tabulated, and the suspected source is indicated if known. In the smaller volume of the Mercury spacecraft the contamination problem is even more acute, since a contaminant can reach the maximum allowable concentration more quickly from a small amount of material. It is important that the exact concentration of each contaminant or group of contaminants be established so that toxic effects and maximum allowable limits can be established by toxicologists. M.P.G.

N64-24609 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SCREENING FOR TOXIC MATERIALS IN THE DESIGN ENGINEERING PHASE
John F. Sheehy *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 19–31 refs (See N64-24606 17-16)

The toxicity surveillance program established by the Navy to determine the potential toxicity of materials introduced into the nuclear submarine by the inclusion of the Polaris Missile System is described. Programs to establish those chemicals in materials which, if released into the atmosphere, would constitute a toxic hazard, and to establish the conditions under which an undesirable effluent release occurs, are also discussed. Two other aspects of the basic atmosphere control program considered are contaminant removal, CO_2 removal, and O_2 regeneration. M.P.G.

N64-24610 California U., San Francisco School of Medicine
PHYSIOLOGICAL EFFECTS AND HUMAN TOLERANCES
Charles H. Hine *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 33–53 refs (See N64-24606 17-16)

The biologic factors that must be considered in the design of closed environments and life-support systems for submarines or spacecraft are reviewed. The factors discussed include physical forces, weightlessness, stress, spatial orientation, temperature, radiation, psychological effects of confinement, nutrition, metabolic end products as contaminants, the maximum allowable concentration of chemical contaminants, oxygen tocicity, carbon dioxide, carbon monoxide toxicity, and the effects of drugs. The life-support systems created must take account of both the flexibility and the limits of adaptability of the human body. M.P.G.

N64-24611 School of Aerospace Medicine, Brooks AFB, Tex.
MICROBIOLOGICAL CONTAMINATION AND ITS EFFECTS IN THE CLOSED ECOLOGICAL SYSTEM
Laurence Irvine *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 55–62 refs (See N64-24606 17-16)

Problems associated with microbiological contamination of manned and unmanned spacecraft are considered as follows: (1) the danger of spacecraft failure due to microorganism-caused corrosion or stoppage in secondary or stabilizing fuel lines; (2) the possibility of mutual contamination between two or more alien planets with organisms harmful to man, animals, agriculture, or atmosphere; (3) the danger of cultuing pathogens or facultative pathogens as part of the waste regeneration system; and (4) the possible buildup of toxic byproducts and noxious gases from microorganisms within the cabin. The need for new automated analytical techniques for rapid microbial detection and identification, and the need for the development of new diagnostic methodology to provide more precise measurements of the health of a man before he enters the machine, are stressed. M.P.G.

N64-24612 Army Chemical Center, Edgewood, Md. Research and Development Labs.
ANIMAL TEST FOR DETECTION OF SUBTLE TOXIC ACTION OF DRUGS OR CHEMICALS
Bernard P. Mc Namara *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 63–75 ref (See N64-24606 17-16)

Six functional tests on animals under the influence of selected drugs known to produce decrement in human performance are described. These tests differ from the standard toxicological tests in that they measure the subtle impairment of normal performance. Drugs of the following classes were studied: adrenergic, antiadrenergic, anticholinergic, anesthetics, analgesics, and tranquilizers. Positive effects in animals could usually be noted with 1% or less of an LD_{50} dose. Comparisons of the doses that produce decrement of performance in animals and man are presented to demonstrate some of the potential and limitations of functional tests in animals. M.P.G.

N64-24613 National Academy of Sciences—National Research Council, Washington, D.C. Prevention of Deterioration Center
HARMFUL EFFECTS ON MATERIALS AND EQUIPMENT
Carl J. Wessel *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 77–102 refs (See N64-24606 17–16)

A review of published data on the effects of deteriorative environments on materials and equipment is presented. The

factors discussed are limited to those that exist in closed ecological systems such as submarines and space cabins and include the following: water vapor (humidity), liquid water (condensates), moderate heat fluxes, salts, acids, alkalies, oxygen, ozone, sulfur dioxide, nitrogen dioxide, miscellaneous gases and aerosols, and fungi and bacteria. All of these factors can be controlled; however, in the cases of water, oxygen, and moderate heat fluxes, conditions nearly optimum for man are in ranges that could cause low-order deterioration reactions of minor importance over long time periods. M.P.G.

N64-24614 Public Health Service, Cincinnati, Ohio
VALIDITY AND HAZARDS OF EXTRAPOLATING THRESHOLD LIMIT VALUES TO CONTINUOUS EXPOSURES
Herbert E. Stokinger *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 103–123 refs (See N64-24606 17-16)

An equation is proposed for extrapolation of threshold limit values (TLV) for industry atmospheres to conditions of the space capsule, and the risks and validity of such an extrapolation are evaluated. The added factors for space travel represent cabin pressure, altered toxicity due to continuous 90-day exposure, temperature, restricted movement, toxicity from continuous exposure to 100% O_2 at 5 psi, fatigue, and an interaction factor. Some TLV's calculated for space travel are tabulated and discussed. The extrapolated values are considered to be reasonable in many instances; however, the calculated limits are too uncertain to be substituted for additional laboratory work and should therefore be considered as benchmark values until improved estimates are obtained. The urgency of deciding whether a one-gas (O_2) or a two-gas system (O_2 and N_2) will be used in the space capsule atmosphere is stressed because completely different toxicologic effects can be predicted for capsule contaminants in one system rather than the other. M.P.G.

N64-24615 Naval Medical Research Inst., Bethesda, Md. Toxicology Unit
LONG-TERM CONTINUOUS INHALATION STUDIES AT THE U.S. NAVAL TOXICOLOGY UNIT
J. Siegel and R. A. Jones *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 125–134 (See N64-24606 17-16)

The sequence of events leading to the establishment of the Navy toxicology unit and its approach to the inhalation hazards associated with continuous long-term exposure to contaminants in closed atmospheres are outlined. Certain physiological parameters of animals exposed to the chemical contaminant in specially designed exposure chambers are monitored. The general approach is to start at a high contaminant level to get positive reactions, then make a run at the TLV level, and then drop to 1/10 of the TLV or to the point of no effect. Materials on which continuous long-term tests have been completed and materials for which guidelines are being established are listed. The need for standardizing the tests being run under various contracts and grants so that the results will be directly comparable is emphasized. M.P.G.

N64-24616 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
THE ENVIRONMENTAL TOXICITY OF SPACE CABIN ATMOSPHERES
A. A. Thomas and K. C. Back *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 135–142 refs (See N64-24606 17-16)

Although spacecraft cabin materials that produce noxious gases and vapors will probably not be much different from those found in submarines, the closed environment of the space cabin poses different problems, such as the management of chemical, algal, bacterial, and perhaps fungal subsystems; cabin operating pressures that will increase the boiloff from common substances; zero-gravity and the delayed settling of particulate matter; radiation decomposition products; and power limitations. To test the validity of extrapolation of industrial TLV's to space conditions, a series of animal experiments were run using a group of metabolic products and a group of propellants. The results indicate that the industrial TLV cannot be used for long-term exposure criteria, and that there are physiological actions and interactions between various contaminants that can be classed as additive, synergistic, or antagonistic. It is suggest that biological evaluations be begun on materials scheduled to be used in research prototype space cabins, so that toxicological data will parallel the developmental schedule. M.P.G.

N64-24617 National Academy of Sciences–National Research Council, Washington, D.C. Advisory Center on Toxicology
PHARMACOLOGICAL ASPECTS OF TOXICOLOGY
Harry W. Hays *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 143–153 refs (See N64-24606 17-16)

The factors that must be considered in the study of the pharmacodynamical effects of a chemical or drug are discussed. These include absorption or route of administration, distribution in the body, method of excretion, metabolism or detoxication mechanisms, sites and mechanism of action, and physical–chemical properties. Other factors influencing the response of the organism include species, sex, weight, age, and temperature, as well as the combinations in which the chemicals are absorbed. The effect of chemicals on enzymes and the effect of enzyme deficiency on drug response are considered. It is predicted that future toxicology studies will be conducted on the cellular level. M.P.G.

N64-24619 Naval Research Lab., Washington, D.C.
DETECTION OF CONTAMINANTS IN THE NUCLEAR SUBMARINE ATMOSPHERE
Homer W. Carhart *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 171–179 refs (See N64-24606 17-16)

Various methods for carbon monoxide analysis are reviewed: direct chemical analysis, catalytic combustion, mass spectrometry, nondispersive infrared techniques, the use of detector tubes, and gas chromatography. Of these methods, the nondispersive infrared technique used in the Mark III analyzer is the most satisfactory. However, in the Mark III, nitrous oxide interferes on an almost 1:1 ratio; i.e., it gives a positive response in the carbon monoxide channel almost equal to that of the monoxide itself. Indirect routine methods, based on adsorption on carbon, and other sampling processes are practiced on nuclear submarines, but the results of the analyses are not available until long after the cruise is over. I.v.L.

N64-24626* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRACE CONTAMINANT REMOVAL
Phillip D. Quattrone *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 269–283 refs (See N64-24606 17-16)

At the present time, a system incorporating an adsorption bed, a catalytic burner unit, and a filtering system to remove aerosols, ions, and particulate matter appears to be feasible for trace contaminant removal. (It is assumed that

separate systems are set up for water vapor, carbon dioxide, and oxygen management, and that the contaminant management system is compatible with these systems.) However, provisions would have to be made for the removal of a number of gaseous products, such as methane, which cannot be completely oxidized in present catalytic burners; the halogen acids that form during the combustion of Freon in a hopcalite burner; and oxides of nitrogen produced by ammonia and other nitrogenous materials. I.v.L.

N64-24627 Lockheed Missiles and Space Co., Palo Alto, Calif.
CARBON DIOXIDE REMOVAL, CONVERSION, AND OXYGEN REGENERATION
J. M. Smith and R. S. Thomas *In its* A Symp. on Toxicity in the Closed Ecol. System [1963] p 285–303 refs (See N64-24606 17-16)

The purpose of this paper is to review allowable carbon dioxide concentration, concepts, and certain devices currently being considered for CO_2 removal and conversion and for O_2 generation for extended manned space flight. Two types of carbon dioxide tolerance relationships are discussed. The first is the permissible limit for continuous exposure. The second is time of exposure vs partial pressure for acute effects. The former will determine the basic design of the removal device; the latter will affect the choice of the backup measures required during both programed and emergency down-times. The three most promising concepts for regenerative CO_2 removal devices—adsorption, electrodialysis, and solidification—are discussed. A number of processes being considered for obtaining O_2 from CO_2 (O_2 generation) are listed as follows: (1) the Sabatier process, (2) direct hydrogenation, (3) electrolysis, (4) the use of a solid electrolyte, (5) CH_4–CO_2 reaction, (6) CH_4 pyrolysis, and (7) hydrocarbon synthesis. I.v.L.

N64-24628 Army Chemical Center, Edgewood, Md. Research and Development Labs.
PARTICLE SIZE CONSIDERATIONS OF AIRBORNE CONTAMINANTS
Charles L. Punte, Jr. *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 305–318 refs (See N64-24606 17-16)

In studies pertaining to air pollution, industrial hazards, or closed-system environments, the size of the airborne particulates is of prime importance. The entry of particles into the respiratory tract, the portion of an inhaled aerosol that is retained in the respiratory tract, and the depth to which the aerosol will penetrate before deposition are all related to particle size. Results of investigations indicate the following: (1) The total retention in the respiratory tract is essentially 100% for particles larger than 10μ. It is about 90% for particles of 5μ, and 75% for particles of 2μ. Retention then drops off rapidly, reaching a minimum of 20% for particles of 0.4μ. (2) Upper respiratory retention (nose and throat) is close to 100% for particles above 10μ. It is about 50% for particles of 2μ and about 5% for particles of 1μ. (3) Particles of 50μ or greater do not enter the nose. I.v.L.

N64-24629 School of Aerospace Medicine, Brooks AFB, Tex.
MEDICAL PROBLEMS IN THE CLOSED ECOLOGICAL SYSTEM
Hans G. Clamann *In* Lockheed Missiles and Space Co., Palo Alto, Calif. A Symp. on Toxicity in the Closed Ecol. System [1963] p 319–322 (See N64-24606 17-16)

Medical problems in a closed ecological system are reviewed briefly in the light of maintaining adequate and even comfortable environmental conditions for crew members so that they may remain at their best physical and mental performance levels. These problems deal with the medical aspects of a habitable cabin atmosphere (cabin pressure) and with regenerative life support systems that recover or convert waste into reusable material. Also, a brief discussion on the maintenance of crew health during an extended space voyage is presented. I.v.L.

N64-24630 Joint Publications Research Service, Washington, D.C.
PECULIARITIES OF THE COURSE OF RADIATION SICKNESS IN MICE SUBJECTED TO TREATMENT WITH MARROW AND BY IMMUNIZATION
O. P. Lebedeva and N. A. Maksimovich 29 Jun. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 2, 1964 p 454–456
(JPRS-25277; TT-64-31572) OTS: $0.50

A study of the pathogenic processes and peculiarities of the course of radiation sickness in immunized mice and in irradiated mice treated with bone marrow is presented. A combination of virological and morphological methods is used in the study. N.E.A.

N64-24685 Joint Publications Research Service, Washington, D.C.
TECHNICAL CYBERNETICS, NO. 1, 1964
1 May 1964 320 p refs Transl. into ENGLISH of Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Tekhn. Kibernetika (Moscow), No. 1, Jan.–Feb. 1964 p 1–208
(JPRS-24536; OTS-64-31235) OTS: $5.00

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N64-24690 Joint Publications Research Service, Washington, D.C.

THE MATRIX METHOD OF MINIMIZATION OF THE NUMBER OF INTERNAL STATES OF NON-SYNCHRONOUS FINITE AUTOMATONS

V. G. Lazarev *In its* Tech. Cybernetics 1 May 1964 p 50–54 refs (See N64-24685 17-16) OTS: $5.00

Transfer matrices are investigated that permit description of the function of automatons, the variations in states of which are caused by transfers of the automaton. A method is proposed for minimization of the number of internal states of automatons of a given class, based on use of the method of symmetrical breakdown of the matrix of states. Author

N64-24700 Joint Publications Research Service, Washington, D.C.

A SELF-ADJUSTING SYSTEM WITH A PATTERN—I.

I. N. Krutova and V. Yu. Rutkovskiy *In its* Tech. Cybernetics 1 May 1964 p 185–198 refs (See N64-24685 17-16) OTS: $5.00

The principle of action and some properties of one type of self-adjusting system with a pattern standard are investigated. The pattern in these systems is one of the basic elements of the self-adjusting curve. It may be used for conversion of a control system, or serve as a standard on the basis of which an analysis of the characteristics of the system may be conducted. G.D.B.

N64-24704 Joint Publications Research Service, Washington, D.C.

ON SYNTHESIS OF A CLASS OF AUTOMATIC CONTROL SYSTEMS UNDER RANDOM EFFECTS

G. A. Agasandyan *In its* Tech. Cybernetics 1 May 1964 p 249–263 refs (See N64-24685 17-16) OTS: $5.00

Automatic control systems are investigated that are described by a differential equation of the LaPlace type. The problem of finding optimum parameters of the system is solved with respect to the criterion of minimum least square error. The peculiarities of such systems are pointed out. Author

N64-24705 Joint Publications Research Service, Washington, D.C.

ON A PROBLEM OF EVALUATION OF ESSENTIAL PARAMETERS OF AN OBJECT

V. P. Zhivoglyadov and Ye. P. Maslov *In its* Tech. Cybernetics 1 May 1964 p 264–274 refs (See N64-24685 17-16) OTS: $5.00

This is an investigation of the application of the theory of statistical solutions to a problem in evaluation of the essential parameters of an object. In an example illustrating the general method, an algorithm is obtained for finding an unknown parameter of a nonlinear object. Author

N64-24706 Joint Publications Research Service, Washington, D.C.

SYNTHESIS OF AUTOMATIC CONTROL SYSTEMS WITH VARIABLES STRUCTURE HAVING A DISCONTINUOUS SWITCHING FUNCTION

S. V. Yemel'yanov and N. Ye. Kostyleva *In its* Tech. Cybernetics 1 May 1964 p 275–281 refs (See N64-24685 17-16) OTS: $5.00

An automatic control system is investigated with variable structure for control of objects with zeros in the transfer function. A new system of coordinates is introduced that is related to the initial ones, with the help of several operators in which the phase trajectories are continuous. A control law is obtained for which the switching hyperplane in this new space occupies a fixed position. The conditions are introduced for producing a sliding region in the entire switching hyperplane. Author

N64-24707 Joint Publications Research Service, Washington, D.C.

OPTIMAL TRANSFER PROCESSES IN A SYSTEM WITH FORECASTING

N. N. Mikhaylov and Zh. A. Novosel'tseva *In its* Tech. Cybernetics 1 May 1964 p 282–294 refs (See N64-24685 17-16) OTS: $5.00

Phase trajectories are investigated for optimal intermediate processes in a system of the third order, consisting of an oscillatory link and an integrator. A method of control is investigated for such a system with the use of forecasting, and results of simulation are presented. Author

N64-24708 Joint Publications Research Service, Washington, D.C.

STABILIZATION OF A SYSTEM OF CONTROL BY INTRODUCTION OF A NON-LINEAR CORRECTION

Ye. D. Viktorov *In its* Tech. Cybernetics 1 May 1964 p 295–304 refs (See N64-24685 17-16) OTS: $5.00

The control stability of a special type with variable parameters by the method of "frozen coefficients" is investigated. It is shown that stability cannot be insured by a linear regulator with constant parameters. A system is proposed for "self-adjusting" filters, the introduction of which permits achievement of stable auto-oscillations. The operation of the control system with the filter is investigated by the means of harmonic balance. Author

N64-24807 Horizons Incorporated, Cleveland, Ohio
DIFFUSION OF GASES THROUGH PLASTIC MEMBRANES Final Report
[1962] 21 p refs
(Contract Nonr-446)
(AD-437359)

Progress is reported on a project designed to obtain data on the factors involved in the extraction of oxygen from sea water by diffusion through thin plastic membranes. It is hoped that these data might be useful in estimating the feasibility of an undersea life-supporting gill based on this principle. Although this general type of system can use either a gas or a liquid on either side of the membranes, this work is primarily concerned with using oxygenated water on the outside and respired air on the inside of the membranes. A few preliminary experiments were also done on the direct oxygenation of blood by passing it between two membranes separated by a screen. R.T.K.

N64-24815* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF HIGH SUSTAINED ACCELERATION ON PILOTS' PERFORMANCE AND DYNAMIC RESPONSE
Melvin Sadoff Washington, NASA, Jul. 1964 61 p refs
(NASA-TN-D-2067) OTS: $1.50

A study was conducted on the human centrifuge to determine the effects of sustained high acceleration on pilot control capabilities. The results showed that the predominant effect of acceleration stress was an increased attenuation of the pilot's dynamic response and an associated large increase in his errors at the higher frequency components in the task command input function. Author

N64-24967 Battelle Memorial Inst., Columbus, Ohio Radiation Effects Information Center
THE BENEFICIAL USES OF RADIATION EFFECTS
J. E. Drennan, D. J. Hamman, and E. N. Wyler 16 Jun. 1964 24 p refs
(Contract AF 33(657)-10085)
(REIC MEMO-25; AD-601493)

The report summarizes beneficial uses of the penetrating abilities of the radiation energies, the use of radiation energies to provide illumination, the exploitation of these energies as a source of useful power, and the use of the radiation energies to change materials and thus make new or improved products. Author

N64-24972* Martin Co., Baltimore, Md.
HUMAN VIBRATION AND IMPACT PROTECTION BY AIR-BAG RESTRAINT SYSTEMS
Carl C. Clark and Carl Blechschmidt N.Y., AIAA [1964] 6 p Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun. – 2 Jul. 1964
(Contract NASw-877)
(AIAA Paper-64-220) AIAA: $0.50 members, $1.00 nonmembers

Manned impact tests of airbag restraint systems in a preliminary experimentation box, a spacecraft simulator, and a passenger airplane simulator have been carried out to show the conceptual feasibility of such active elastic restraint systems, whose restoring forces can be varied by varying bag pressures to insure the prevention of "bottoming." These systems can isolate from high-frequency (above 5 cps) vibration and impact loads, transmitting less than 50% and often less than 25% of the loads on the "vehicle." Rebound effects occur at a low enough frequency (near 3 cps) that they are physiologically acceptable, without any bag pressure dumping or valving. Author

N64-25000* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEASURED VARIATIONS IN THE TRANSFER FUNCTION OF A HUMAN PILOT
James J. Adams and Hugh P. Bergeron Repr. from J. of Aircraft, v. 1, no. 2, Mar.–Apr. 1964 p 77–81 Presented at the AIAA/ASD (AFSC) Vehicle Design and Propulsion Meeting, Dayton, Ohio, 4–6 Nov. 1963
(NASA-RP-206)

A method for determining the transfer function of a human pilot as he operates on a closed-loop control system was devised and used in single-axis compensatory tracking tasks and two-axis tasks both with and without cockpit movement. The transfer functions were then used analytically to obtain closed-loop characteristics. Author

N64-25040 School of Aerospace Medicine, Brooks AFB, Tex.
CONTROLLED CONTAMINATION: A PRACTICAL APPROACH FOR DEVELOPING STERILIZATION PROCEDURES FOR SEALED COMPONENTS OF SPACECRAFT
Joseph T. Cordaro, Henry Buchanan, Bruce Mann, and A. K. Miller (Lockheed Missiles and Space Co.) Sep. 1963 10 p refs
(Contract AF 41(609)-1544)
(SAM-TDR-63-73; AD-437645) OTS: $1.10

Deliberate contamination of components during manufacture appears both practical and feasible for developing sterilization procedures for spacecraft components. Thus, it is possible to determine whether normal manufacturing procedures are sufficient to sterilize or whether the sterilization procedures required (e.g., temperature–time intervals for dry heat) to sterilize can be accomplished without component damage. Methods are presented for controlled contamination with bacterial spores highly resistant to dry heat and bacteriologic recovery of such spores. Impregnated (e.g., with polybutylene) capacitors were rendered sterile during manufacture; nonimpregnated capacitors were not. Any damaging effects of heat sterilization might be increased if the components were subjected to further heating when installed in circuits of spacecraft instrumentations. Author

N64-25054* National Aeronautics and Space Administration, Washington, D.C.
ACCELEROMETRIC PRECORDIAL BALLISTOCARDIOGRAM (KINETOCARDIOGRAM) IN HYPERTENSION [AKTSELEROMETRICHESKAYA PREKARDIAL'NAYA BALLISTOKARDIOGRAMMA (KINETOKARDIOGRAMMA) PRI GIPERTONICHESKOY BOLEZNI]
I. Ye. Oranskiy Jul. 1964 10 p refs Transl. into ENGLISH of Terap. Arkh. (Moscow), v. 34, no. 12, 1962 p 27–32
(NASA-TT-F-198) OTS: $0.50

The phase structure of the cardiac cycle in hypertension was determined by analysis of the kinetocardiogram (KCG). The observations included 70 patients between the ages of 19 and 77. In 39 of the patients the basic condition was accompanied by atherosclerotic cardiosclerosis. The changes in

hemodynamics that occur in hypertension were found to be mainly connected with changes in strength and time in the isometric contraction phase and in the phase of ejection of blood from the ventricles. Author

N64-25078 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PRINCIPLE OF THE DOMINANT AND A. A. UKHTOMSKIY'S CONCEPT OF THE CHRONOTOPE (TIME-SPACE COMPLEX)
V. L. Merkulov 25 Mar. 1964 33 p refs Transl. into ENGLISH from USP. Sovrem. Biol. (Moscow), v. 47, no. 2, 1959 p 204–219 refs
(FTD-TT-63-1806/1+4; AD-600157)

This article tries to systematize Soviet scientist A. A. Ukhtomskiy's published and unpublished material on the chronotope, and compares it to the theories of I. M. Sechenov and N. Y. Wedensky. These theories occurred in his principle of the dominant and in his chronotope concept. The dominant principle is further discussed and compared with Ukhtomskiy's reasoning concerning the interaction between the dominant and the perception of the chronotope by human and animal sense organs and brain. G.D.B.

N64-25111 California U., Davis School of Veterinary Medicine
THE EFFECTS OF X-RADIATION ON WORK CAPACITY AND LONGEVITY OF THE DOG Annual Progress Report No. 13
A. C. Andersen Jun. 1964 185 p refs
(Contract AT(04-3)-472)
(UCD-472-109) OTS: $2.75

A colony of beagles is in its 13th year of existence as a project to determine work capacity and longevity in dogs exposed to X-radiation. The report lists the beagles by subgroup, gives the present status of the experimental colony, gives ophthalmoscopic findings in experimental dogs, presents six psychological studies in irradiated adult female beagles, discusses the effect of X-irradiation on reproduction by female beagles, presents a pathology report on the beagles, and discusses survival of X-irradiated beagles. G.D.B.

N64-25115* IIT Research Inst., Chicago, Ill. Life Sciences Div.
SURVIVAL OF MICROORGANISMS IN A SIMULATED MARTIAN ENVIRONMENT. II *BACILLUS SUBTILIS* VAR. *GLOBIGII*
C. A. Hagen, E. J. Hawrylewicz, and R. Ehrlich Repr. from Appl. Microbiol., v. 12, no. 3, May 1964 p 215–218 refs
(Contract NASr-22)

Survival of *Bacillus subtilis* of the variety *globigii* in a simulated Martian environment was demonstrated. Previous contact with the simulated Martian soil or atmosphere reduced germination or outgrowth of unheated spores, or both. Inoculation into simulated Martian soil and then flushing with a simulated Martian atmosphere were lethal to both vegetative cells and spores. After one diurnal temperature cycle (26° to −60° C), the majority of cells present were spores. No further effect of the diurnal cycle on survival was noted in any of the experimental samples. Author

N64-25125 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
NEURAL MECHANISMS FOR RESPONSES OF MIDDLE EAR MUSCLES Final Report, 1 Jan. 1962–31 Dec. 1963
William D. Neff [1963] 40 p refs
(Contract DA-49-193-MD-2230)
(Rept.-1128; AD-439381)

In the experiments summarized in this report, the aim was to observe and record the activity of the middle ear muscles under different conditions of reflex arousal by sound and to study the neural control circuitry by noting the effects of central nervous system lesions involving different pathways and centers thought to be part of the control circuitry. G.D.B.

N64-25127 George Washington U., Washington, D.C.
PIONEER VI REPORTED VISUAL SENSATIONS AS A FUNCTION OF SUSTAINED SENSORY DEPRIVATION AND SOCIAL ISOLATION Research Memorandum
Donald B. Murphy, Thomas I. Myers, and Seward Smith Nov. 1963 136 p refs
(Contract DA-44-188-ARO-2)
(AD-439431)

Tests for reported visual sensation were administered to subjects undergoing voluntary sensory deprivation and social isolation and to subjects in a control condition characterized by a normal range of sensory and social experiences. The results of this research are reported. G.D.B.

N64-25132* National Aeronautics and Space Administration, Washington, D.C.
PROBLEMS OF SPATIAL PERCEPTION AND SPATIAL CONCEPTS
B. G. Anan'yev and B. F. Lomov, ed. Jun. 1964 278 p refs Transl. into ENGLISH of the book "Problemy Vospriyatiya Prostranstva i Prostranstvennykh Predstavleniy" Moscow, Izd. Akad. Ped. Nauk RSFSR, 1961
(NASA-TT-F-164) OTS: $4.00

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N64-25133* National Aeronautics and Space Administration, Washington, D.C.

THE SYSTEMIC MECHANISM OF SPATIAL PERCEPTION AND THE SYNERGETIC ACTIVITY OF THE CEREBRAL HEMISPHERES

B. G. Anan'yev *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 4–11 (See N64-25132 17-16) OTS: $4.00

There is a fundamental similarity between the mechanism of spatial perception and perception in general, which is based on a complex conditioned reflex response to a complex stimulus. The mechanism of spatial perception and its outstanding features are discussed. Experimental evidence is cited that demonstrates that the systemic mechanism of spatial perception is a combination of intermodal associations based on complex conditioned reflexes and the synergetic distinctively human dynamics of the symmetry and asymmetry of the functions of the organs of perception. R.T.K.

N64-25134* National Aeronautics and Space Administration, Washington, D.C.

THE FUNCTIONAL STRUCTURE OF SPATIAL ANALYSIS

E. Sh. Ayrapet'yants *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 12–27 (See N64-25132 17-16) OTS: $4.00

The mechanisms of spatial relations in the behavior of animals and the pathways and structure of spatial analysis, particularly in the areas of higher nervous activity are discussed. The combined role of motor responses and cutaneous activity in spatial analysis is stressed. R.T.K.

N64-25135* National Aeronautics and Space Administration, Washington, D.C.

ASPECTS OF THE SYNERGETIC ACTIVITY OF THE CEREBRAL HEMISPHERES IN CERTAIN VERTEBRATES

E. Sh. Ayrapet'yants and V. L. Bianki *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 28–33 (See N64-25132 17-16) OTS: $4.00

Experimental evidence is presented that the synergetic activity of the cerebral hemispheres is important for visual spatial analysis. There is reason to believe that in vertebrates at different phylogenetic levels visual spatial orientation is related to the functional interaction of the symmetric centers of paired cerebral formations. R.T.K.

N64-25136* National Aeronautics and Space Administration, Washington, D.C.

ELECTROENCEPHALOGRAPHIC INDICATORS OF BINOCULAR VISION AND DISTURBANCE IN BINOCULAR VISION

A. N. Dobromyslov *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 34–44 (See N64-25132 17-16) OTS: $4.00

Objective evidence of the relation between the conical endings of the visual analyzer in binocular vision, and when such vision is disturbed, is provided by the EEG (electroencephalogram) investigations carried out on 120 subjects with binocular and nonbinocular vision. To study the functional state of the cortical endings of the visual analyzer, experiments were also run on puppies with disturbance of binocularity. Records were made of the biocurrents in the occipital region. In addition, the critical fusion frequency in 141 persons, normal subjects and patients with disturbed binocularity, was investigated. R.T.K.

N64-25137* National Aeronautics and Space Administration, Washington, D.C.
ON THE MENSURATIONAL FUNCTION OF THE ANALYZERS
B. F. Lomov *In its* Probl. in Spatial Perception and Spatial Concepts Jun. 1964 p 45–52 refs (See N64-25132 17-16) OTS: $4.00

The mensurational function and the characteristics of the sensory measurement of space are discussed. The perception of distance is one of the most general functions of the analyzers. In one form or another it appears in orientation, synthesis of shapes, measurement, verification, and correction. R.T.K.

N64-25138* National Aeronautics and Space Administration, Washington, D.C.
ON THE ROLE OF THE OCULOMOTOR SYSTEM IN SPATIAL VISION
L. I. Leushina and Ye. P. Kok *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 53–63 refs (See N64-25132 17-16) OTS: $4.00

In order to analyze the role of eye movements in spatial vision and to study the mechanisms of spatial vision, the oculomotor system in patients with defective spatial perception was investigated. To record the eye movements, the electro-oculographic (EOG) method was used. All patients with defective spatial perception showed a derangement of the sensory link of the oculomotor system. The degree of defectiveness of spatial vision corresponded to the degree of derangement of the sensory link. R.T.K.

N64-25139* National Aeronautics and Space Administration, Washington, D.C.
THE CONDITIONED REFLEX BASIS OF THE VISUAL PERCEPTION OF SPACE
B. Kh. Gurevich *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 64–71 (See N64-25132 17-16) OTS: $4.00

Using the electro-oculographic method, the "visual" and the conditioned reflex movements in the fixation reflex (the rotation of the eyes toward light) were studied in normal subjects. The results of the investigation suggest that the apparent contradiction between the "peripheral" theories of spatial perception (Sherrington) and the "central" or "centrifugal" theories (Helmholtz) can be removed by the consistent extension of Pavlov's conditioned reflex theory to the sensory arcs of the reflexes—the sensory links of behavior. R.T.K.

N64-25140* National Aeronautics and Space Administration, Washington, D.C.
ON THE ACTIVE NATURE OF PERCEPTION OF THE DISTANCE OF MOVING OBJECTS
V. Ya. Dymerskiy *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 72–77 refs (See N64-25132 17-16) OTS: $4.00

Perception of motion is based on the reflection of space–time relationships. On the basis of mathematical formulas that are given, and experiments that have been conducted, the following is concluded: Under conditions of motion, the perception of the absolute distance of an object occupying the whole visual field and of changes in its absolute distance is possible only on the basis of a particular system of stimulation. In addition to stimulations of the retina, this system must include stimulations produced by the work of the eye muscles, which insures the particular position and nature of motion of the line of regard. This conclusion is valid both for the case of motion of an object relative to a fixed observer and for the case of motion of the observer himself. R.T.K.

N64-25141* National Aeronautics and Space Administration, Washington, D.C.
SOME INDIVIDUAL DIFFERENCES IN PERCEPTION OF DEPTH
A. V. Skripchenko *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 78–82 (See N64-25132 17-16) OTS: $4.00

The experiment reported was designed to investigate certain individual peculiarities in depth perception with one object moving toward or away from the subject, while another object was fixed. For this purpose a modified Howard–Dolman instrument was used. Analysis of the experimental data shows considerable individual variations in accuracy and consistency in determining the equidistance of moving and fixed objects. Stereoscopic sensitivity varied with the direction of movement of the moving object. One group of subjects was able to determine equidistance between a fixed object and an object moving toward the eyes. In another group of subjects depth perception was almost independent of the direction of movement of the object, but stereoscopic sensitivity varied. In the majority of cases the errors in the accuracy of determining equidistance was distributed asymmetrically. No direct correlation was found between the accuracy and consistency of determinations of equidistance. R.T.K.

N64-25143* National Aeronautics and Space Administration, Washington, D.C.
THE ROLE OF SPEECH IN THE REFLECTION OF SPACE
A. V. Yarmolenko *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 96–99 (See N64-25132 17-16) OTS: $4.00

By studying the formation of complex spatial notions in normal and pathological subjects, it was concluded that these notions fall into two types—the route map and the survey map. The data on the individual development of spatial notions in children demonstrate the relation between these two types as stages in the development of a spatial system of notions and their conversion to a system of spatial concepts. The second type is a later and a higher phenomenon, since the reference points and aspects of the space are localized in a relatively constant fashion, are objective, and are independent of the relative movements of the perceiver. The generalized relationship between the concepts and the notions determines a system of verbally expressed spatial concepts. R.T.K.

N64-25144* National Aeronautics and Space Administration, Washington, D.C.
DEVELOPMENT OF TEMPORARY CONNECTIONS BASED ON THE SPATIAL RELATIONS OF STIMULI IN YOUNG CHILDREN
A. N. Znamenskaya *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 100–107 (See N64-25132 17-16) OTS: $4.00

The object of this investigation was to clarify the role of the motor and visual analyzers in the formation of conditioned reflex responses to the spatial position of objects. Normally developing children who ranged in age from 3 to 4 months and from 2 to 4 years were used as subjects. The study was based on the conditioned-reflex motor method. On the basis of the experiments the following conclusions were drawn: (1) In the development of temporary connections and differentiation of spatial objects in infants 3 to 4 months old, as well as in children 2 to 4 years old, the mechanism of accommodation is important, but the motor analyzer plays the main role. (2) Under these conditions direct stimuli are of extremely great importance to children 2 to 4 years old, while the role of verbal signals remains secondary. R.T.K.

N64-25145* National Aeronautics and Space Administration, Washington, D.C.
DEVELOPMENT OF SPATIAL DISCRIMINATION IN CHILDREN OF PRESCHOOL AGE
M. V. Vovchik-Blakitnaya *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 108–114 (See N64-25132 17-16) OTS: $4.00

The object of the investigation was to clarify the nature and means of discrimination of the spatial position of objects by preschool children, as well as to investigate orientation in a plane. In addition to systematic observations of children engaged in various practical activities and at play in kindergarten, natural experiment was performed—play with objects and games of lotto with the images of objects in various positions on the cards. These experiments were intended to determine the ability of children to correlate the position of objects in space with the position of their plane images, and also their ability to verbalize the content of the corresponding concepts. R.T.K.

N64-25146* National Aeronautics and Space Administration, Washington, D.C.
MASTERY OF THE SIZE OF OBJECTS BY PRESCHOOL CHILDREN
V. K. Kotyrlo *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 115–120 (See N64-25132 17-16) OTS: $4.00

The object of this investigation was to trace the process of the perception of the size of objects in the spatial orientation of preschool children in different age groups. The discrimination by children of the overall size of an object, representing some combination of its three dimensions (height, length, and width) and in the discrimination of each of its three dimensions separately, was studied. Eighty kindergarten pupils, 3 to 7 years old, were the subjects. Experimental results demonstrated that the apprehension of the size of objects by preschool children is most closely tied to the development of the differentiation, abstraction, and generalization of the different spatial attributes of objects of the material world. As the general spatial orientation of preschool children develops, their apprehension of size also improves. R.T.K.

N64-25147* National Aeronautics and Space Administration, Washington, D.C.
THE DEVELOPMENT OF AN UNDERSTANDING OF SPATIAL RELATIONS AND THEIR REFLECTION IN THE LANGUAGE OF CHILDREN OF PRESCHOOL AGE
T. A. Museyibova *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 121–129 (See N64-25132 17-16) OTS: $4.00

The results of the study of the child's ability to discriminate spatial relations between objects are presented. An analysis of the material obtained as a result of getting the children to perform various individual tasks shows that acquiring the ability to differentiate spatial relations is a long and complicated process. The disentangling of spatial relations—their abstraction from objects—is a difficult mental task for the small child. The data that were accumulated confirm this observation. R.T.K.

N64-25148* National Aeronautics and Space Administration, Washington, D.C.
THE DEVELOPMENT OF SPATIAL PERCEPTION AND SPATIAL CONCEPTS IN PRESCHOOL CHILDREN
B. A. Sazont'yev *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 130–143 (See N64-25132 17-16) OTS: $4.00

As shown by experiments involving drawing tasks (drawing a toy or some other object), the chief difficulty encountered by preschool-age children is that they are still not capable of spatial perception and have not acquired the habit of depicting space on a sheet of paper. Preschool children do not comprehend the significance of such rules as taking into account the position of the object relative to the draftsman's eye or drawing the object from a single fixed viewpoint. During an experiment in which children were instructed to explore and find the simplest ways of drawing objects in three dimensions, it was found that the spatial perception of nature becomes properly coordinated and complemented by a concern for the third dimension. R.T.K.

N64-25149* National Aeronautics and Space Administration, Washington, D.C.
DIRECTED PERCEPTION OF PROPORTIONS BY FIRST-GRADE PUPILS DURING NATURE DRAWING
Yu. M. Mukhin *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 144–148 refs (See N64-25132 17-16) OTS: $4.00

An investigation is described of the process of directed perception of proportions in first-grade students observed during nature drawing studies. These investigations were primarily focused on clarifying the conditions necessary for the formation of directed perception of proportions, in order to gain, through an analysis of these conditions, a somewhat closer understanding of the psychological aspects of the problem. R.T.K.

N64-25150* National Aeronautics and Space Administration, Washington, D.C.
RELATIONSHIP BETWEEN SPATIAL AND QUANTITATIVE CONCEPTS IN STUDENTS IN THE FOURTH TO SIXTH GRADES
Ye. P. Tonkonogaya *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 149–160 (See N64-25132 17-16) OTS: $4.00

The ability to perceive relations between spatial and quantitative concepts independently increases with the accumulation of knowledge in the course of formal education. However, this process is a very slow one. Fourth-grade pupils can distinguish spatial relations independently and independently synthesize spatial and quantitative concepts in mapping routes and in solving arithmetic problems with the aid of a sketch. R.T.K.

N64-25151* National Aeronautics and Space Administration, Washington, D.C.
DEVELOPMENT OF SPATIAL CONCEPTS IN ELEMENTARY SCHOOL PUPILS
O. I. Galkina *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 161–169 ref (See N64-25132 17-16) OTS: $4.00

The methods used were psychological and pedagogical observations made during lessons, control and independent projects in the classroom, individual psychological experiments, and conversations with individual children. Because of the difficulty of determining the spatial concept, various methods of objectifying it in terms of the products of the children's various activities were used—drawing, modeling, sketching, problem solving, story telling, handicrafts, etc. The experimental results concluded that there is a gap between the children's spatial concepts and the end of their primary school education and the demands of the curriculum. R.T.K.

N64-25152* National Aeronautics and Space Administration, Washington, D.C.
PERCEPTION OF SPATIAL RELATIONS BY SIXTH GRADE PUPILS DURING FIELD SURVEYING EXERCISES

V. I. Zykova *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 170–177 (See N64-25132 17-16) OTS: $4.00

The perception of spatial relations was investigated in pupils engaged in field surveying exercises under the sixth-grade geometry program. These exercises are very important in connection with the technical education of the students and as demonstrations of the practical aspects of geometry. Experimental results indicated the following: (1) Discrimination between clockwise and counterclockwise directions in designating the vertices of a survey polygon raises the students to a high level of perception of spatial relations in drawing the corresponding plan, and thereby contributes to reducing the number of cases of mirror-image reversal. (2) Improving the spatial perception of the students to a level at which analogous problems can be solved depends on the specific means by which the necessary stage of perception of spatial relations is reached in the process of drawing survey plans. R.T.K.

N64-25153* National Aeronautics and Space Administration, Washington, D.C.

PERCEPTION AND REPRESENTATION OF THE SHORTEST DISTANCE ON THE MAP AND ON THE GLOBE

F. N. Shemyakin *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 178–187 (See N64-25132 17-16) OTS: $4.00

Subjects associated the verbal formulation of the straight-line axiom with the sensory generalization of their experience in moving over comparatively small portions of the earth's surface, within which its curvature has virtually no effect. There is a lack of generalized sensory experience in recognizing the shortest distance on the surface of a sphere, with which the words "shortest distance" could be associated. R.T.K.

N64-25154* National Aeronautics and Space Administration, Washington, D.C.

KINESTHETIC SPATIAL DISCRIMINATION IN THE PRACTICE OF SPORTS

A. Ts. Puni *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 188–198 refs (See N64-25132 17-16) OTS: $4.00

This report on kinesthetic spatial discrimination in sports is devoted to a survey of the accumulated findings concerning only one of the aspects of this highly complex problem, that pertaining to man's perception of the spatial properties of the movements of his own body. The facts presented show that systematic sports training greatly improves the analytic-synthetic activity of the motor analyzer in athletes. Evidence is presented indicating that the development of kinesthetic spatial discrimination is based not only on improvements in the activity of the motor analyzer, but also on interaction between this analyzer and the speech-signaling system. R.T.K.

N64-25155* National Aeronautics and Space Administration, Washington, D.C.

THE DYNAMICS OF THE SPATIAL ATTRIBUTES OF MOVEMENTS IN THE PROCESS OF FORMATION OF IMAGES OF GYMNASTIC EXERCISES

Ye. N. Surkov *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 199–206 refs (See N64-25132 17-16) OTS: $4.00

The dynamics of the spatial attributes of movements in the process of forming images of gymnastic exercises was studied by means of psychopedagogical experiments. Material related to the teaching of forward handsprings is presented. The subjects were pupils in the sixth and seventh grades. There were 10 subjects, all new to acrobatics. A total of 200 experiments were performed. The process of forming motor concepts was studied in connection with the determining influence of different methods of pedagogical instruction. R.T.K.

N64-25156* National Aeronautics and Space Administration, Washington, D.C.

INTERACTION OF THE SPATIAL, DYNAMIC, AND TEMPORAL COMPONENTS OF THE WORKING MOVEMENT IN LEARNING TO FILE METAL

V. Ye. Bushurova *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 207–213 ref (See N64-25132 17-16) OTS: $4.00

In filing, the effect of the tempo of the movements on their amplitude and intensity was studied. The variations in the chief characteristics of the movements when various analyzers were partially or wholly eliminated were investigated. The results show that, on the whole, the elimination of different analyzers does not have a very marked effect on performance, especially in the performance of a skilled worker. The higher the level of skill attained by the worker the less is the effect. Even with vision, hearing, touch, and the sense of vibration "eliminated," kinesthesia insures the sufficiently distinct analysis of all the characteristics of the working movement. Therefore, the experiment demonstrates that it is actually kinesthesia that plays the leading role in the analysis of time, pressure, and the trajectory of the movements. R.T.K.

N64-25157* National Aeronautics and Space Administration, Washington, D.C.

THE ROLE OF SPATIAL PERCEPTION IN WORK AT A CONVEYER

B. A. Fedorishin *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 214–218 (See N64-25132 17-16) OTS: $4.00

The studies reported were conducted in Leningrad in plants employing the belt-conveyer system of production. Results demonstrated that the workers' perception of space and spatial relations play a significant role in the success with which a given production operation is mastered and executed at a required speed. At the same time, these observations enabled the isolation, from the complex of spatial perception of those elements that have the greatest effect on the working process of the individual worker. R.T.K.

N64-25158* National Aeronautics and Space Administration, Washington, D.C.

SOME PROBLEMS OF THE PSYCHOPHYSIOLOGY OF ILLUSIONS OF THE SPATIAL POSITION OF AIRCRAFT IN INSTRUMENT FLYING

Ye. A. Derevyanko, Ye. S. Zav'yalov, and T. Kh. Gurvich *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 219–230 (See N64-25132 17-16) OTS: $4.00

By means of discussions and questionnaires the frequency, duration, and conditions of occurrence of illusions in flying personnel was determined. Methods of combatting these illusions were investigated. Flight experiments were organized in a specially equipped aircraft in order to study: (1) the characteristics of instrument flying; (2) the possibilities of maintaining horizontal flight without receiving visual information; (3) the effect of acceleration on spatial orientation in instrument flying; and (4) the effect of acceleration on the determination of spatial position when the observation of instrument readings is interrupted. R.T.K.

N64-25159* National Aeronautics and Space Administration, Washington, D.C.
THE ROLE OF SPATIAL CONCEPTS IN MAP READING AND THE INTERPRETATION OF AERIAL PHOTOGRAPHS
M. V. Gamezo and V. F. Rubakhin *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 231–246 (See N64-25132 17-16) OTS: $4.00

The results of solving a series of experimental problems—drawing relief by means of contour lines from given elevation; analysis of relief forms depicted on the map by contour lines with a deliberate error; reproduction of terrain elements based on a preliminary study of maps and aerial photographs, etc.—conclude that the interpretations formed by reading a topographic map or interpreting an aerial photograph create conceptual problems. The mind visualizes these maps and photos either in the form of two- or three-dimensional images of real terrain or in the form of conventionally schematized, reduced images essentially resembling a relief model or a schematic representation of the terrain with individual massive elements; these forms of images may be products of either the memory or the imagination. R.T.K.

N64-25160* National Aeronautics and Space Administration, Washington, D.C.
THE ROLE OF SPATIAL IMAGINATION IN THE WORK OF THE DESIGNER AND IN THE TEACHING OF DRAWING IN TECHNICAL SCHOOLS
Ye. L. Surin *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 247–253 (See N64-25132 17-16) OTS: $4.00

The teaching of descriptive geometry is discussed. It is felt that the nonaxial method of drawing reduces the gap between descriptive geometry and technical drawing. Evidence is presented indicating that it would be profitable to dispense with Monge's method of teaching descriptive geometry. The nonaxial method of making complex drawings is recommended instead. R.T.K.

N64-25161* National Aeronautics and Space Administration, Washington, D.C.
CONTRIBUTION TO THE EXPERIMENTAL INVESTIGATION OF SPATIAL IMAGINATION
B. F. Lomov *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 254–262 (See N64-25132 17-16) OTS: $4.00

The object of this investigation of students of drawing and design was to study the process of conceptualization or, more exactly, the process of operation with spatial images. On the basis of the experimental results it is concluded that the process of formation of a mental operation on a spatial image involves three main stages: (1) working with a real object, (2) external operations on an imagined object, and (3) mental operations on the concept. R.T.K.

N64-25162* National Aeronautics and Space Administration, Washington, D.C.
VISUAL SPATIAL DISCRIMINATION AS A COMPONENT OF THE CAPACITY FOR WORK
M. D. Aleksandrova *In its* Probl. of Spatial Perception and Spatial Concepts Jun. 1964 p 263–273 refs (See N64-25132 17-16) OTS: $4.00

An investigation was made of the evolution of the analyzer functions of man with age. The simplest and most general factors in spatial discrimination responsible for effective regulation of motor actions were examined. Such factors include, primarily, the field and acuity of vision. The simplest forms of visual estimation, which is a result of visual-motor coordination, was also measured. The subjects consisted of 11 persons, 50 to 80 years old, who were still active in work and in social life. R.T.K.

N64-25172* Martin Co., Baltimore, Md.
CONTROL SYSTEM LAGS AND MAN-MACHINE SYSTEM PERFORMANCE
F. A. Muckler and R. W. Obermayer Washington, NASA, Jul. 1964 35 p refs
(Contract NASw-718)
(NASA-CR-83) OTS: $1.00

This review examines the manual control system literature on the effects of system lags to clarify major conceptual, analytic, and terminological problems. Four control system lags are defined—transmission, exponential, sigmoid, and oscillatory transient delays. The effects of lags on human performance are illustrated through studies of single control lag variables. However, since the interaction of task variables markedly influences tracking performance levels, an analysis of the control lag literature is conducted across the following task variables—system inputs, information sources, operator controls, controlled element, and environmental variables. Additionally, the relation between control lags and the procedural variable of transfer of training is discussed. Author

N64-25196 Joint Publications Research Service, Washington, D.C.
GROWTH-RELATED CHANGES IN THE ZINC CONTENT OF HUMAN BLOOD
T. L. Dubina 7 Jul. 1964 9 p refs Transl. into ENGLISH from Vestsi Akad. Navuk BSSR, Ser. Biol. Navuk (Minsk), no. 1, 1964 p 87–89
(JPRS-25364; TT-64-31637) OTS: $0.50

To ascertain the laws of growth-related changes in the zinc level in whole blood, the blood of 653 healthy children and adolescents, ages 7 to 18, was tested. The results of the analysis are presented and discussed. G.D.B.

N64-25198 Joint Publications Research Service, Washington, D.C.
DETERMINATION OF CERTAIN TRACE ELEMENTS IN RADIATION DERMATITES
A. Ya. Prokopchuk, A. T. Sosnovskiy, M. Z. Yagovdik, and Z. I. Orlova 17 Jul. 1964 15 p refs Transl. into ENGLISH from Vestsi Akad. Navuk BSSR Ser. Biol. Navuk, (Minsk), no. 1, 1964 p 92–96
(JPRS-25502; TT-64-31774) OTS: $0.50

The study of the amount of cobalt, nickel, copper, and zinc in the blood and in affected, scarry-changed skin under limited experimental radiodermatitis of rabbits is presented. Also studied is the amount of these trace elements in the blood of patients diseased with radiodermatitis. The amount of cobalt and zinc in the blood and affected skin of the rabbits has a tendency to increase. The amount of nickel in the blood does not appreciably change, but in the affected skin there is noted a tendency to increase. At the height of the development of radiation dermatitis there is an increase of the concentration of copper in the blood and in the affected skin. There is noted an increase of the amount of cobalt, nickel, and copper in the blood of patients ill with radiodermatitis. N.E.A.

N64-25204 California U., Berkeley Lawrence Radiation Lab.
BRAIN SEROTONIN AND BEHAVIOR IN SELECTED STRAINS OF RATS
Gordon T. Pryor Jan. 1964 289 p refs
(Contract W-7405-ENG-48)
(UCRL-11179) OTS: $3.50

This study of brain serotonin and behavior in selected strains of rats attacks the problem by discussing brain biochemistry and behavior; the role of serotinin; strain differences in noncholinergic systems; within-strain correlations between brain morphology, biochemistry, and behavior; and the effects of an enriched versus an impoverished environment on brain serotonin. G.D.B.

N64-25205 Argonne National Lab., Ill. Metallurgy Div.
DOSIMETRY FOR RADIATION DAMAGE STUDIES
A. D. Rossin Mar. 1964 21 p refs
(Contract W-31-109-ENG-38)
(ANL-6826) OTS: $0.50

A method is presented for reporting fast-neutron exposure in a meaningful and unambiguous fashion. The steps involve determination of spectrum shape, absolute magnitude, an energy weighting for the neutrons, and a unit for reporting exposure. Various methods for performing the procedure are described, and the reasoning behind the approach is explained. Author

N64-25206* National Aeronautics and Space Administration, Washington, D.C.
DYNAMOCARDIOGRAPHY
Ye. B. Babskiy and V. L. Karpman Jul. 1964 144 p refs
Transl. into ENGLISH of the book "Dinamokardiografiya" Moscow, State Publishing House for Med. Lit., 1963
(NASA-TT-F-205) OTS: $2.75

The theoretical principles of a new method of investigating cardiac activity and some practical results are presented in this book. Dynamocardiography operates on the moment-of-force analysis of mechanical processes associated with cardiac contraction and measurements of the resultant displacement of the center of gravity of the thorax with respect to a plane support on which the patient lies. These physical processes produce complex curves having seven characteristic intervals that reveal certain manifestations of cardiac kinematics and thoracic hemodynamics. The changes in the curves indicate diagnostic data for mitral stenosis, adhesive pericarditis, and atherosclerotic cardiosclerosis. Further applications are: (1) the quantitative, objective evaluation of the functional state of the heart and the extent of thoracic circulation disruption and (2) the evaluation of the effectiveness of medical and surgical treatment in normalizing heart action. Author

N64-25235 Stanford Research Inst., Menlo Park, Calif.
LINEAR SEPARABILITY OF SIGNAL SPACE AS A BASIS FOR ADAPTIVE MECHANISMS Final Report
N. J. Nilsson Griffiss AFB, N.Y., RADC, May 1964 78 p refs
(Contract AF 30(602)-2943)
(RADC-TDR-64-145; AD-601849)

In this report it is suggested that the problem of the selection of discriminant functions constitutes the primary problem in the design of pattern classifying machines. Several classes of discriminant functions and some means of implementing them are discussed. Also, training methods for the selection of discriminant functions are presented. The new and existing material on trainable pattern classification machines was organized around the framework provided by the notion of discriminant functions to provide a basis for further theoretical development. Some specific new results were added to the theory of trainable pattern classifying machines. These are the capacity and generalization capabilities of the threshold logic units; Φ-functions and their use as discriminant functions; the comparison of the (1,0) versus the (1,−1) mode for pattern presentation; the boundedness of the length of the threshold logic unit weight vector during training; majority logic and committee machines; and feature detection. The geometrical construction of a majority rule solution committee and a majority solution committee for the parity function are presented. I.v.L.

N64-25296 Stanford Research Inst., Menlo Park, Calif.
A SIMPLE MODEL OF A PATTERN RECOGNITION SYSTEM
D. J. Hall Apr. 1964 28 p
(Contract DA-36-039-AMC-03247(E))
(TN-1; AD-600079)

A simple pattern-recognition model is presented, based upon principles similar to those used for the learning machine MINOS II, which is now operational. The model demonstrates the ability to recognize imperfect versions of S, R, and I, (which may be drawn free-hand and may vary to a certain extent in size and position), thus displaying the basic properties of discrimination and generalization. The method used to select 10 "efficient" masks from a larger set of proposed masks is realistic in terms of computing time and can be used as a basis for understanding mask design for MINOS II. I.v.L.

N64-25308 Texas A&M Research Foundation, College Station Radiation Biology Lab.
CHRONIC WHOLE-BODY GAMMA RADIATION STRESS IN THE ALBINO RAT AND MOUSE Progress Report, Mar. 1963–Jun. 1964
Sidney O. Brown Apr. 1964 99 p refs
(Sponsored by Army)
(AD-600960)

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1. IRRADIATION AND THE HEMATOLOGY OF THE ALBINO RAT: HEMATOPOIETIC RECOVERY FOLLOWING CONTINUOUS AND FRACTIONATED RADIATION George M. Krise, Gertrude M. Adam, R. L. Lawson, and H. B. Pace p 1–4 refs (See N64-25309 18-16)

2. IRRADIATION AND THE HEMATOLOGY OF THE ALBINO RAT: EFFECTS OF CONTINUOUS AND FRACTIONATED CHRONIC RADIATION AT DOSE RATES OF 5 AND 10 r PER DAY George M. Krise, Gertrude M. Adam, and Geraldine Mc Ginty p 5–7 refs (See N64-25310 18-16)

3. THE EFFECT OF CONTINUOUS AND FRACTIONATED LOW INTENSITY GAMMA RADIATION IN RESISTANCE TO COLD STRESS IN THE ALBINO RAT—A PROGRESS REPORT Rommon L. Lawson, Sidney O. Brown, and George M. Krise p 8–12 refs (See N64-25311 18-16)

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5. EFFECTS OF CONTINUOUS IRRADIATION ON MAMMALS—A PRELIMINARY COMPILATION OF THE LITERATURE—DECEMBER 1963 J. W. Austin and E. W. Hupp p 21–53 refs (See N64-25313 18-16)

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N64-25309 Texas A&M Research Foundation, College Station
IRRADIATION AND THE HEMATOLOGY OF THE ALBINO RAT: HEMATOPOIETIC RECOVERY FOLLOWING CONTINUOUS AND FRACTIONED RADIATION

George M. Krise, Gertrude M. Adam, R. L. Lawson, and H. B. Pace *In its* Chronic Whole-Body Gamma Radiation Stress in the Albino Rat and Mouse, Apr. 1964 p 1–4 (See N64-25308 18-16)

This is a study of the recovery of the hematopoietic system following exposure of the whole animal to continuous and macrofractionated doses of gamma irradiation. A total of 100 mature male albino rats were selected and divided into five radiation-exposure groups. Upon completion of the irradiation schedule, blood samples were analyzed. The damage to the specimens resulting from the experiments is discussed. G.D.B.

N64-25310 Texas A&M Research Foundation, College Station

IRRADIATION AND THE HEMATOLOGY OF THE ALBINO RAT: EFFECTS OF CONTINUOUS AND FRACTIONATED CHRONIC RADIATION AT DOSE RATES OF 5 AND 10 r PER DAY

George M. Krise, Gertrude M. Adam, and Geraldine Mc Ginty *In its* Chronic Whole-Body Gamma Radiation Stress in the Albino Rat and Mouse, Apr. 1964 p 5–7 (See N64-25308 18-16)

The absence of a cyclic response in weight of albino rats or in WBCC in the case of the weekly fractionated doses of 5 r or 10 r per day as seen in higher dose schedules seems to indicate that insufficient damage occurred during the irradiation periods to elicit a marked hyperplastic response of the hematopoietic system or of the animal as a whole. Perhaps, if irradiation is to be considered as a nonspecific stressor, the stress presented by these dose levels is insufficient to bring about an alarm reaction and the subsequent period of adaptation that might be used to explain the cyclic nature exhibited at higher dose rates. G.D.B.

N64-25311 Texas A&M Research Foundation, College Station

THE EFFECT OF CONTINUOUS AND FRACTIONATED LOW INTENSITY GAMMA RADIATION IN RESISTANCE TO COLD STRESS IN THE ALBINO RAT Progress Report

Rommon L. Lawson, Sidney O. Brown, and George M. Krise *In its* Chronic Whole-Body Gamma Radiation Stress in the Albino Rat and Mouse, Apr. 1964 p 8–12 refs (See N64-25308 18-16)

The plan of this study was to investigate the effects of continuous and fractionated low-intensity radiation on the ability of the albino rat to withstand environmental thermal stresses. This first phase of the program is designed to study the effect of the radiation regimen when it is applied previous to the cold stress; the temperature used was 5° C with 82% humidity. Methods, procedures, and results—body weight, cold injury, etc.—are given. G.D.B.

N64-25312 Texas A&M Research Foundation, College Station

EFFECT OF CONTINUOUS OR FRACTIONATED LOW INTENSITY GAMMA RADIATION ON RESISTANCE TO HEAT STRESS IN THE ALBINO RAT

E. W. Hupp, S. U. Ahmed, H. B. Pace, and S. O. Brown *In its* Chronic Whole-Body Gamma Radiation Stress in the Albino Rat and Mouse, Apr. 1964 p 13–20 refs (See N64-25308 18-16)

The purpose of this investigation was to study the effect of continuous and weekly fractionated doses of gamma radiation administered in daily doses of 20 r to a total accumulated dose of 1,000 r on the resistance of the albino rat to heat stress. The environmental heat stress produced by a temperature of 93° F and 90% RH was applied immediately after the completion of the radiation regime. The clinical appearance of the animal, body weight changes, rectal temperature, gross and histopathologic appearance of organs, and survival were the chief criteria of radiation damage. G.D.B.

N64-25313 Texas A&M Research Foundation, College Station

EFFECTS OF CONTINUOUS IRRADIATION ON MAMMALS—A PRELIMINARY COMPILATION OF THE LITERATURE—DECEMBER 1963

J. W. Austin and E. W. Hupp *In its* Chronic Whole-Body Gamma Radiation Stress in the Albino Rat and Mouse, Apr. 1964 p 21–53 refs (See N64-25308 18-16)

Literature is cited, quoted, and discussed in an effort to clarify the effects of continuous irradiation on mammals. An alphabetic bibliography is included in this paper. G.D.B.

N64-25314 Texas A&M Research Foundation, College Station

EFFECTS OF VARIOUS LEVELS OF ACUTE AND CHRONIC RADIATION ON SPERM VOLUME, TOTAL SPERM COUNT, PER CENT MOTILITY, PER CENT LIVE AND NORMAL SPERM, AND PER CENT ABNORMAL SPERM

Rommon L. Lawson and Sidney O. Brown *In its* Chronic Whole-Body Gamma Radiation Stress in the Albino Rat and Mouse, Apr. 1964 p 54–62 (See N64-25308 18-16)

The purpose of this investigation was to observe the effect of continuous and fractionated radiation doses on sperm activity. The sperm reflect the radiation damage to the testes since they are the end product of testicular proliferation. Sperm in the human are easily obtained and may be used as an indicator of radiation injury in much the same way as the lymphocytes. The effect of whole-body radiation on fertility of male rats was examined by systematic weekly matings of treated males. G.D.B.

N64-25323 Army Research Office, Washington, D.C. Life Sciences Div.

A STUDY OF THE MILITARY APPLICABILITY OF RESEARCH ON ASCORBIC ACID

Wendell H. Griffith 12 Aug. 1963 55 p refs
(Contract DA-49-092-ARO-9)
(AD-429526)

Current research on ascorbic acid that is applicable to military needs is discussed. The military importance of these studies is indicated by the fact that the formation of connective tissue is indispensable for wound healing and that research on the biogenesis of collagen of connective tissue is, in fact, research on a basic aspect of the function and mechanism of action of ascorbic acid. The hydroxylation reaction, on which the synthesis of collagen's hydroxyproline depends, may be the metabolic reaction that underlies much of the vitamin's activity in the body. Author

N64-25331 Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

BIODYNAMICS: PAST, PRESENT AND FUTURE

Ellis R. Taylor Mar. 1963 24 p refs
(ARL-TDR-63-10; AD-402084)

A brief operational definition of biodynamics is presented. Following a condensed history of the field, including a review of weaknesses of the transient mechanical analytic approach, present biological research activities are listed. A definition of working relationships between disciplines is advanced. Author

N64-25338 School of Aerospace Medicine, Brooks AFB, Tex.

MAXIMUM PRESSURE-VOLUME RELATIONSHIPS OF THE HUMAN RESPIRATORY SYSTEMS

Louis F. Johnson, Jr. May 1964 10 p refs
(SAM-TDR-64-21; AD-601601)

Maximum respiratory pressure-volume relationships were determined in five experienced male subjects by three methods: (1) by exerting pressures against a mercury U-tube manometer; (2) by exerting pressures against an occluded breathing tube with the subject sitting in a full-body plethysmograph; and (3) by maximally exhaling into and inhaling from a series of different-sized containers. Greater expiratory and inspiratory pressures could be exerted against infinite resistance (methods 1 and 2) than against variable resistance (method 3). Author

N64-25340 Chicago U., Ill.

INFLUENCE OF X-IRRADIATION ON DEVELOPMENT OF MICROSOME OXIDASE AND REDUCTASE ACTIVITY IN THE LIVERS OF YOUNG MALE RATS

Bernard E. Hietbrink and Kenneth P. Dubois Brooks AFB, Tex., School of Aerospace Med., Jun. 1964 10p refs
(Contract AF 41(609)-1693)
(SAM-TDR-64-29; AD-601792)

A study was conducted on the influence of X-ray on the development of an oxidase in liver microsomes that catalyzes the oxidative desulfuration of phosphorothioates. Exposure of 23-day-old male rats to 200 r or 400 r almost completely inhibited the development of phosphorothioate oxidase activity during the 3-week observation period following radiation. Substantial inhibition of the development of oxidase activity was also observed after exposure of the animals to 100 r. Marked inhibition of the development of the enzyme activity in regenerating livers of partially hepatectomized rats was observed following exposure to X-ray of 200 r to 600 r. The absence of an inhibitory effect by X-ray-irradiation on the phosphorothiote oxidizing activity of the livers of adult male rats suggests that the effect of X-ray is on some process involved in the synthesis of phosphorothioate oxidase. X-ray-irradiation had no effect on the development of reductase activity in the livers of young rats, indicating selectivity in the action of X-ray on the development of microsome enzymes. Author

N64-25355 Martin Co., Baltimore, Md.

TRAINING PLAN—SLOW MALFUNCTION MONITORS LV 305A

D. E. Farr 28 Feb. 1964 26 p refs

Ground monitors are needed to provide the capability of recognizing slowly developing malfunctions in order to increase the probability of mission success by permitting manual switchover to the secondary control system. This training plan includes the steps to be taken for the training and evaluation of ground monitor–observer personnel. The training events are programed to prepare three persons in the recognition and diagnosis of slow malfunction problems. Candidate selection is included since it is necessary for monitor candidates to have considerable background knowledge and experience. The monitor's primary task is real-time monitoring of the flight performance of the guidance, primary, and secondary control systems, and the operation of the various airborne discretes. The responsibility includes crew safety and a continuous appraisal of mission success in terms of constraint violations and one and one-half orbit capability. Task analysis methodology and a sample work sheet are included in this plan as an indication of the scope of interest in providing training and evaluation data. I.v.L.

N64-25383 Stanford U., Calif.

THE DISTRIBUTION OF BLOOD FLOW IN HUMAN SKIN Annual Progress Report, Jul. 1, 1962–Jun. 30, 1963

J. M. Crismon [1963] 6 p refs
(Contract DA-49-193-MD-2311)
(AD-411171)

A new method of measuring and recording volume increase for the measurement of forearm blood flow by venous occlusion plethysmography is reported. The radiofrequency capacitance bridge method was used to avoid temperature change inaccuracies. Also, the role of diffusion in skin circulation was examined with a mathematical model and by the clearance method, using ^{131}I in anesthetized rats. The slow clearance rate, it was concluded, does not clearly reflect the circulation rate. D.E.W.

N64-25455 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SOME RESULTS OF THE STUDY OF THE BIOLOGICAL EFFECT OF NEUTRONS AND PROTONS

27 Apr. 1964 23 p refs Transl. into ENGLISH from the Publ. Nekotoryye Itogi Izuch. Biol. Deystviya Neytronov i Protonov (USSR), 1963 19 p
(FTD-TT-63-1046/1+4; AD-600785)

A survey was made of the current technology of determining the relative biological effectiveness (RBE) of neutron and protons. Experiments are cited and an evaluation, which includes the following, is made. (1) More work on explaining the qualitative properties of the neutron biological effect is exceptionally important both on a general radiobiological plane and to solve the practical questions of radiation safety. (2) More research is needed on the characteristics of the biological effect of protons. (3) The judgment of the RBE by mortality and acute demonstration of radiation damage can lead to erroneous conclusions. Evidently, the RBE of different types of ionizing radiation should be evaluated only from the total reaction of the whole organism, in which the adaptating and compensating mechanisms conceal, for a long time, the damage arising in separate systems. I.v.L.

N64-25458 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SOME PROBLEMS OF RECORDING HEART SOUNDS

A. I. Koblents-Midshke 23 Mar. 1964 15 p refs Transl. into ENGLISH from Elektron. V Med. (Moscow), 1960 p 110–119
(FTD-TT-63-1193/1+2+4; AD-436840)

Phonocardiography requires the development of a recorder with a directly readable recording, calculated on a frequency transmission up to 800 cps. Selection of a standard system of frequency characteristics of the apparatus is recommended. Standardizing the conditions of conducting sounds to the sensing element of the microphone, or neutralizing the changes of these conditions, is desirable. Development of apparatus that represents sound pressure not only in a linear but also in a logarithmic scale is suggested. G.D.B.

N64-25462 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

TOXICITY OF CERTAIN ISOALCOHOLS, HIGHER ALCOHOLS, AND MELAMINE-FORMALDEHYDE RESINS

K. P. Stasenkova and R. N. Mel'nikova 28 Apr. 1964 7 p refs Transl. into ENGLISH from Toksikol. Novykh Prom. Khim. Veshchestv (USSR), no. 3, 1961 p 108–112
(FTD-TT-64-97/1+4; AD-600812)

Investigations were conducted of the toxicity of isoalcohols with boiling ranges of 112° to 148° C and 138° to 175° C, higher alcohols with boiling ranges of 165° to 225° C, and three forms of melamine–formaldehyde resins prepared from the above alcohols. Results include the following: (1) The clinical picture of severe intoxication in white mice, white rats, and rabbits, through breathing the fumes of the chemicals, was characterized by symptoms of narcotic and irritating actions. No animals died. (2) Intragastrical injections of 10 g/kg of all alcohols killed 100% of the test specimens (white mice and white rats). Autopsies revealed acute hyperemia of the mucous membrane of the stomach and small intestines, and sometimes there was hemorrhaging in these organs. A 5 g/kg dose caused 60% death when isoalcohols with a boiling range of 112° to 148° C were injected. The remaining alcohols were not lethal in this dose. A 5 g/kg injection of the melamine–formaldehyde resins produced from these alcohols did not cause death; however, symptoms of intoxication appeared. (3) One short application of the alcohols and resins on the skin of rabbits caused hyperemia, fine punctate intradermal extravasation, subsequent scabbing, shallow fissures, dryness, and desquamation of the skin. Complete recovery came after two weeks. I.v.L.

N64-25472 Massachusetts Inst. of Tech., Cambridge
FAST NEUTRON SPECTROSCOPY AND DOSIMETRY OF THE MIT REACTOR MEDICAL THERAPY FACILITY BEAM Scientific Report No. 3
Roger A. Rydin, Norman C. Rasmussen, and Gordon L. Brownell (Ph.D Thesis) May 1964 254 p refs
(Contract AF 19(604)-7492)
(MITNE-47; AFCRL-64-404; AD-602057)

The neutron spectrum was measured using a combination of foil detectors. The foil activation data were obtained by gamma-ray spectrum analysis and decay curve analysis. Decay curves for Al^{28} and Mg^{27} were analyzed using FRANTIC, an iterative, weighted, least-squares exponential growth and decay data fitting program. FRANTIC was also used to fit gross fission product decay curves from Np^{237}, U^{238}, Th^{232}, and U^{235}. The fast neutron spectrum was calculated from the threshold foil data using the Weighted Orthonormal and Weighted Orthonormal Polynomial Methods, which were coded for the IBM 7090 computer. A composite neutron spectrum was constructed using the results of the fast, epithermal, and thermal flux measurements. This was used to compute the dose rate in tissue using Snyder's Monte Carlo results for a broad beam of neutrons. The calculated gamma-ray dose was then compared to experimental results. Author

N64-25491* Brandeis U., Waltham, Mass.
ANTIBODIES TO HUMAN A_1 HEMOGLOBIN AND THEIR REACTION WITH A_2, *S*, *C*, AND *H* HEMOGLOBINS
Morris Reichlin, Malgorzata Hay, and Lawrence Levine Repr. from Immunochem., v. 1, 1964 p 21–30 refs
(Grants NsG-375; C-221; NIH E-1940)

Antibodies with specificity toward A_1 human hemoglobin have been produced in rabbits. The antisera were identified as antihemoglobin by use of agar diffusion and immunoelectrophoresis, the demonstration of the dependence of complete serologic reactivity on the presence of hematin, and the quantitative recovery of hematin in the immune precipitate. The anti-A_1 sera distinguish the mutant hemoglobins *S* and *C* from A_1 by microcomplement fixation but not by quantitative precipitation. The antigenic difference in the abnormal hemoglobins is probably a result of a change in conformation at the *N*-terminus of the β chain. The quantitative reaction of human hemoglobin A_2 and *H* was also studied. A_2 hemoglobin was less effective serologically than *S* or *C*. Hemoglobin *H* reacted with anti-A_1 as measured by inhibition of A_1-anti-A_1. Variable amounts of antibodies directed toward the β chain were found in the three antisera. Author

N64-25511 Lockheed Missiles and Space Co., Sunnyvale, Calif.
RADIATION EFFECTS UPON EXPERIMENTAL ANIMALS, MAN, AND PLANTS: AN ANNOTATED BIBLIOGRAPHY, VOL. II, M-Z
Jack B. Goldmann, comp. Jan. 1963 440 p refs For Vol. I see N64-20517 13-16
(SB-62-60, vol. II; Rept.-5-10-62-54, vol. II; AD-438178)

This is an annotated bibliography of publications relating to radiation effects on living matter, arranged alphabetically by author. An author index is included. G.D.B.

N64-25512 Miami U., Coral Gables, Fla. Bascom Palmer Eye Inst.
HUMAN ELECTRORETINOGRAPHY AS A GAUGE OF VISUAL PERFORMANCE First Annual Progress Report, Sep. 1, 1962–Jun. 1, 1963
Thorne Shipley [1963] 22 p
(Contract DA-49-193-MD-2344)
(AD-602526)

This report covers 191 human electroretinograms taken in the ERG laboratories, with reference to doubling of *a* and *b* components; correlation with dark—adaptation; general inhibitory effects; general systemic ERG inhibition and enhancement; binocular interaction effects; and ERG in relation to maturation. It also covers supportive animal studies. Author

N64-25572* Spacelabs, Inc., Van Nuys, Calif.
DEVELOPMENT OF AN IMPEDANCE PNEUMOGRAPH Final Report
Joseph R. Smith, Jr. 28 May 1964 37 p refs
(Contract NAS2-1097)
(NASA-CR-56834; SR-64-1006) OTS: $3.60 ph

A research and development program directed toward the design and fabrication of an improved impedance pneumograph was carried out. The relationship between impedance measurement and volumetric changes during breathing was examined. A series of tests were conducted to provide information regarding the effects of electrode placement, electrode design, and body movement on the various components of the impedance change. This study aided the design of a new impedance pneumograph signal conditioner. G.D.B.

N64-25655 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TECHNICAL PROCEDURES FOR DETECTING WEAK BIOELECTRICAL RESPONSES
V. A. Kozhevnikov 24 Mar. 1964 14 p refs Transl. into ENGLISH from Elektron. V Med. (Moscow-Leningrad). 1960 p 120–129
(FTD-TT-63-1194/1+2+4; AD-438783)

The recording of biological responses is discussed. A device has been developed that increases the sweep time to 100 sec. Beam intensity modulation rides a carrier frequency (100 cps) that permits the recording of slow changes and the d.c. component of the signal. For cases of nonrhythmic application of stimulation, a device is used in which the stepwise displacement of the traces is accomplished by means of an electromechanical relay system. Delay of the moment of stimulation, from the start of the trace, and the length of this delay are provided by a phantastron circuit. With nonrhythmic application of stimulation, it is possible to record up to 100 traces on a single frame, and as many as 400 or

more when the stimulations are rhythmic. It is possible to record, in the form of a three-dimensional chart, the results of a repeated observation of an electrogram on a single frame. It is necessary to determine the average value of the voltage as a function of the time computed from the moment of stimulation application, on the basis of the accumulated measurements, in order to distinguish the components of the electrogram (i.e., the responses) associated with the applied stimuli. This determination is made by photometry of the obtained picture. Signals lying 20 db below the normal detection level can be clearly detected. I.v.L.

N64-25767* Baylor U., Houston, Tex. Coll. of Medicine
DEVELOPMENT OF AN ELECTRODE FOR LONG TERM APPLICATION IN BIOLOGICAL RECORDING Final Report
Robert Edelberg (Houston State Psychiat. Inst.) Oct. 1963 94 p refs
(Contract NAS9-445)
(NASA-CR-56205) OTS: $8.60 ph

The feasibility of converting various materials including cellulose, leather, and human skin from a nonconductor to a good conductor by infiltration with silver salt and subsequent reduction was demonstrated. A method suitable for use on humans was developed and produced skin resistances of the same order as those measured on a conventional wet electrolytic site. A skin solder consisting of a suspension of conducting particles in a polyvinylpyrrolidone matrix was developed. The deterioration of the high conductivity of silver-infiltrated human skin was due to a progressive oxidative process rather than to mechanical disruption of the conducting lattice, and various protective measures were effective in reducing this deterioration. G.D.B.

N64-25768* California U., Berkeley
EXPERIMENTAL RESEARCH ON HEMODYNAMIC AND METABOLIC FUNCTIONS IN PRIMATES Semi-Annual Status Report, 1 Aug. 1963–31 Jan. 1964
Nello Pace et al [1964] 14 p
(Grant NsG-170-61)
(NASA-CR-56348; Rept.-4) OTS: $1.60 ph

The current program status includes the following: (1) Two new general procedures, one for long-term restraint and the other for chronic vascular catheter implantation, have been developed. (2) Analytical chemical procedures for the following urinary constituents are presently in operation: total osmotic activity, sodium, potassium, calcium, magnesium, ammonia, chloride, phosphate, sulfate, urea, uric acid, creatinine, glucose, 5-hydroxyindoleacetic acid, 17-ketosteroids, 17-hydroxycorticosteroids, epinephrine, norepinephrine, and dopamine. (3) A procedure for in vivo measurement of total body water content, by means of tritium-labeled water, is now operational. (4) New physiological baseline data obtained on the pigtailed monkey are summarized. These data pertain to reproduction and growth, hematology, hemodynamics, and body temperature. I.v.L.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-24236 Air Force Systems Command, Wright-Patterson AFB, Ohio
SLIDING FRICTION OF COPPER Technical Documentary Report, May 1962 – Aug. 1963
Tung Liu Mar. 1964 28 p refs
(RTD-TDR-63-4257; AD-435675)

To satisfy future Air Force requirements, the present knowledge on the sliding friction and wear was reviewed and found to be inadequate. More experimental data with better controlled environmental conditions are needed. To fulfill this need, a versatile sliding friction apparatus has been designed, constructed, and tested. As the initial phase of the work, friction between copper specimens was investigated. The sliding friction between copper specimens was measured under atmospheric conditions under loads of 0.1 to 20 grams. With very clean surfaces, the coefficient of friction was 1.0 to 1.1 for the entire load range. With less clean surfaces, the coefficient of friction obtained was about 0.4. Since the degree of cleanliness cannot be controlled quantitatively, the friction–load curve of sliding copper pairs in air exhibits a bifurcation characteristic. The higher friction value may be satisfactorily explained by adhesion theory. No sign of adhesion, however, was detectable when the friction coefficient was 0.4. All observations to date indicate that plastic deformation exists during the sliding process. Using published data on the total expended work in plastic deformation, the coefficient of friction between copper pairs was estimated to be about 0.2. When adhesion is negligible, based on the plastic deformation mechanism, one may deduce that the friction coefficient depends largely on the properties of the softer material of the two specimens and that, upon repeated sliding, a slight drop in friction may be observed. Author

N64-24264 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A FLEXIBLE SPRING ELEMENT DESIGNED FOR TURBINE ROLLER BEARINGS
G. Guetter 11 Dec. 1963 8 p Transl. into ENGLISH from German Patent 22489, 11 Jan. 1962 p 1–4
(FTD-TT-63-161/1+2; AD-434978)

The spring element consists of a flat, circular, elastic ring disk, with rigid pressure rings on both sides. The pressure rings have lobes that slightly distort the spring disk when axially loaded into a cup shape. The element is especially designed for thrust loading of ball- or roller-bearing assemblies on small, high-speed turbines to prevent oscillation and ensuing bearing fracture. D.E.W.

N64-24357 Excelco Developments, Inc., Silver Creek, N.Y.
ROLLED AND WELDED FABRICATION OF 18% Ni MARAGING STEEL
W. D. Abbott *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 303–305 (See N64-24351 17-18)

A 120-in.-diam solid propellant rocket engine test case was built of 1/2-in.-thick, 18%-nickel maraging steel, 250 ksi, and was tested by a multistage hydroburst test. The closure burst at 2,015 psi, with the shearing of all bolts holding it to the case. Stress at hydroburst, as calculated and checked with strain gage readings, was 215,000 psi. No permanent deformation of any part of the case was detected. This was the highest stress to which any large, high-strength case has ever been tested. D.E.W.

N64-24358 Lear Siegler, Inc., El Segundo, Calif. Astro Structures Div.
SPIN FORGE PROCESSING OF THE 300 KSI GRADE MARAGING 18% Ni STEEL

R. P. Sernka *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 307–326 (See N64-24351 17-18)

Three shapes of cylindrical chambers were shear spun (spin forged) from the 300-ksi grade of 18% nickel maraging steel. Diameters were 11.7 in., 44 in., and 65 in. The shear spinning process is described in detail, and dimensions and drawings are given. Mechanical and dimensional properties were tested, and data are given. Stated conclusions apply to the ease of forming, the amount of wall reduction possible, methods of raising the tensile strength, and dimension changes. D.E.W.

N64-24366 Misco Precision Casting Co., Muskegon, Mich.
INVESTMENT CAST MARAGING STEEL BY THE MONO-SHELL PROCESS
R. J. Wilcox *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 503–526 refs (See N64-24351 17-18)

Maraging steel has been successfully produced in investment cast form, using the double-vacuum MonoShell process. Quality level, as determined by visual, X-ray, magnetic particle and fluorescent penetrant examination, compares favorably with high-quality investment castings made from other alloys. While maraging steel develops strength levels among the highest studied to date for investment castings, it is indicated that the ability to develop full-strength and ductility capabilities from test bars cut from castings depends upon the degree of soundness and freedom from microporosity that can be achieved by means of sound design and gating practice. Heat-treatment studies show that the optimum practice for the 18% nickel grade should consist of air cooling from the 2,100° F for annealing or homogenization temperature, followed by maraging at 900° F. Test bars cast to the wrought alloy composition show somewhat higher strength than those made from the recommended casting composition. Studies at elevated temperatures indicate that useful strength levels are maintained up to approximately 800° F, after which the drop in ultimate and yield strengths begins to accelerate. Author

N64-24578 Joint Publications Research Service, Washington, D.C.
ELECTRONIC MELTING UNITS
In its Arc Furnaces and Electron. Smelting 26 May 1964 p 44–62 (See N64-24576 17-01) OTS: $1.75

The operation is described of two types of electronic smelting furnaces—those using annular cathodes and radial electron guns, and those using axial electron guns. Circuit diagrams for the power supplies and automatic regulation systems are included. D.S.G.

N64-24585 Joint Publications Research Service, Washington, D.C.
EXPERIENCE IN THE PRODUCTION OF CAST TURBINE BLADES FROM HEAT-RESISTANT ALLOYS
K. P. Lebedev and M. N. Yefimova *In its* Casting Properties of Heat-Resisting Alloys 5 Jun. 1964 p 51–62 (See N64-24582 17-18) OTS: $1.75

The highly stressed cast turbine rotor blade can be produced by the free-casting method of investment casting in the case where the alloy is not scale-forming. The consistent set of mechanical properties is obtained by pouring the form through a header system having a slotted feeder. J.L.D.

N64-24876 Allegheny Ludlum Steel Corp., Brackenridge, Pa. Research Center
TANTALUM ALLOY TUBING DEVELOPMENT PROGRAM Second Interim Technical Engineering Report, 15 Oct. 1963–15 Jan. 1964
F. S. Turner Wright-Patterson AFB, Res. and Technol. Div., Jan. 1964 15 p refs
(Contract AF 33(657)-11261)
(RTD-8-109(II); AD-429049)

Efforts were devoted to material procurement and to tooling design and manufacture. Detailed drawings of the dies, mandrels, dummy blocks, etc. are presented. Author

N64-24921 Lockheed Missiles and Space Co., Sunnyvale, Calif.
GEARS, BEARINGS AND LUBRICANTS FOR AEROSPACE APPLICATIONS: AN ANNOTATED BIBLIOGRAPHY
Helen M. Abbott, comp. Aug. 1963 93 p refs
(Contract AF 94(647)-787)
(SB-63-59; Rept.-3-77-63-1; AD-441583)

This compilation of 189 annotated references is divided into two parts: (1) gears and bearings, and (2) lubricants and lubrication techniques. This material provides a coverage of the literature from October 1961 through August 1963. Subject, author, and corporate source indexes are included. Author

N64-24928 Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
PRODUCTION ENGINEERING MEASURE Third Quarterly Report, Jan. 1–Mar. 31, 1964
Hauw T. Go [1964] 34 p
(Contract DA-36-039-AMC-03617 (E))
(AD-601676)

The objective of this program is to improve production techniques in order to increase the reliability of a silicon planar transistor and microelectronic monolithic circuitry. Results of the program to improve the processes of assembly, diffusion, and photochemistry are reported. The results of reliability tests are included. R.T.K.

N64-24934 Knights (James) Co., Sandwich, Ill.
HIGH PRECISION 5MC QUARTZ RESONATORS FOR TEMPERATURE CONTROL BETWEEN 20° AND 30° C Combined Reports I, II, and III, 20 Jun. 1963–20 Feb. 1964
[1964] 45 p
(Contract NObsr-89290)
(AD-601524)

The design and production of 5 mc, 5th overtone, quartz resonator units to operate on the extremely flat portion of the characteristic AT frequency–temperature curve, between 20° and 30° C, is discussed. Data on actual units is compared with calculations, and limits are discussed. Some preliminary data on aging is included. Very small frequency anomalies, possibly resulting from coupled modes, are described. Author

N64-24954 Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PISTON-SLAP NOISE IN RECIPROCATING MACHINERY
Eric E. Ungar, Donald Ross, and Franklin F. Alvarez (MIT) 15 Apr. 1964 77 p refs
(Contract NObs-88480)
(Rept.-1106; AD-439205)

The most important component of mechanical noise of reciprocating machinery appears to be that due to "piston slap", i.e., due to the impacts associated with lateral piston motions across cylinder clearance spaces. This noise mechanism can account for several observed characteristics of diesel engine noise not readily explained by the more popular theories, which consider, essentially, only effects of cylinder gas pressure changes. Expressions for estimating vibrations and noise produced by piston slap in any type of reciprocating machine are developed in this report. Comparisons are made

between calculated and measured sound levels, and reasonable agreement is found. Author

N64-25010* Westinghouse Electric Corp., Lima, Ohio Aerospace Electrical Div.
RESEARCH AND DEVELOPMENT PROGRAM ON MAGNETIC, ELECTRICAL CONDUCTOR, ELECTRICAL INSULATION, BORE SEAL MATERIALS Third Quarterly Report, Mar. 1–May 30, 1964
P. E. Kueser et al Mar. 1964 175 p refs
(Contract NAS3-4162)
(NASA-CR-54089; WAED-64.30E) OTS: $12.50 ph

Mechanical tests have shown that high-saturation materials such as iron–cobalt are not suitable for high-stress applications at elevated temperature. The 50 Co–50 Fe material also undergoes atomic ordering at elevated temperature, thereby increasing the coercive force. Nivco (23 Ni–1.1 Zr–1.8 Ti–Co) has the best creep properties of potential rotor materials for temperatures in excess of 900° F. Several new dispersion-strengthened copper conductors have been developed, as well as austenitic stainless steel-clad conductors. Weight-loss tests on insulations in vacuum have shown the importance of prior treatment on material performance, since all samples showed a high initial loss rate that later tapered off. Ceramic-to-metal seals using high-purity ceramics and silica-free metalizings appear to be marginal in strength. Emphasis is now being placed on active metal brazing methods for fabricating ceramic-to-metal seals. Author

N64-25045 Standard Pressed Steel Co., Jenkintown, Pa.
STRUCTURAL FASTENING TECHNOLOGY First Progress Report, Jul.–Oct. 1963
E. F. Gowen, Jr. and M. Ortner (Vitro Labs, West Orange, N.J.) 4 Nov. 1963 80 p refs
(Contract AF 33(657)-11684)

A survey of available refractory materials, user refractory fastener requirements, and refractory coatings was conducted. The results of the survey and resultant recommendations are presented. Work was started on the actual requirements of a coated refractory fastener in a joint. TZM material with Vitro coating was used. Author

N64-25200 Tung-Sol Electric, Inc., Livingston, N.J. Chatham Electronics Div.
ELECTRON TUBES RADIATION RESISTANT PILOT LINE PRODUCTION Quarterly Progress Report, 1 Sep.–30 Nov. 1963
F. B. Parks and John F. Grimm 31 Dec. 1963 59 p
(Contract DA-36-039-AMC-01476(E))
(QPR-2; AD-439240)

Improvements were made to the stem-making and glass-sealing equipment, as well as to the stem-forming molds. The techniques and processes pertaining to both these operations were modified in line with the indicated direction of higher yield and lower shrinkage. Work proceeded with the design and construction of essential equipment, such as the high temperature, dual vacuum exhaust station; the 500° C life test kit; power preheaters, static characteristics sets, aging racks, and a voltage-gain test set; and modification to the pinch-press type sealing machine for the 5886 tube. Author

N64-25230 International Business Machines, Kingston, N.Y.
CRYOGENIC ASSOCIATIVE PROCESSOR PLANE TEST AND EVALUATION Final Report
G. B. Rosenberger Griffiss AFB, N.Y., RADC, Jun. 1964 29 p
(Contract AF 30(602)-3175)
(RADC-TDR-64-26; AD-602067)

The fabrication and testing of a cryogenic associative processor are described in this report. The processor consisted of 2,350 cryotrons interconnected to form ten 12-bit words of associated storage. The cryotrons and the necessary control circuitry were vacuum-deposited on a 4 1/2- × 4 1/2-in. substrate. Polymer-type insulation was used. The fabrication process and the reasons for limited success of the program are discussed in detail. Author

N64-25231 American Power Jet Co., Ridgefield, N.J.
RELIABILITY PREDICTION FOR MECHANICAL AND ELECTROMECHANICAL PARTS Final Report
George Chernowitz, Samuel J. Bailey, Angelo W. Castellon, and Gerald L. Geltman Griffiss AFB, N.Y., RADC, May 1964 291 p refs
(Contract AF 30(602)-2991)
(RADC-TDR-64-50; AD-601784)

The reliability of selected parts is investigated from the viewpoint of materials behavior throughout parts-materials history, including process, fabrication, test, handling, and early operation. The parts studied are mechanical (bearings and gears) and electromechanical (brushes and contacts). Failure mechanisms were examined on the basis of a SCWIFT taxonomy: S—stress–creep Rupture; C—corrosion; W—wear; I—impact; F—fatigue; and T—thermal. Dominant among the mechanisms of failure were wear and fatigue phenomena. A multistage process was developed for organizing analytical and empirical investigation of part failure causes in a broader sense, based on materials influences that may be statistically related to part survival. The definition of a retrospective part survival function was proposed. Data and relationships covering flaw propagation, fracture, corrosion, surface fatigue, and the influence of materials and manufacture are given for the parts studied. Author

N64-25318 General Electric Co., Auburn, N.Y. Rectifier Components Dept.
THE IMPROVEMENT OF PRODUCT ON TECHNIQUES TO INCREASE THE RELIABILITY OF DIFFUSED SILICON CONTROLLED SWITCHES Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. N. Frank, A. H. Shta, R. C. Rome, H. Wawrousek, and W. R. Comstock [1964] 34 p refs
(Contract DA-36-039-AMC-03619(E))
(QPR-3; AD-601442)

Progress is reported on a production engineering measure (PEM) for the improvement of production techniques to increase the reliability of an all-diffused silicon controlled switch, of the 2N689 type. The work performed on the device package, the all-diffused silicon controlled rectifier subassembly, the determination of consequences upon electrical behavior of dislocation-impurity interaction in all-diffused silicon, and the results of blocking voltage step-stress tests conducted on the present alloy-diffused product are presented. A PERT analysis depicts the progress of this program and provides for certain conclusions based upon the work performed. Author

N64-25324 National Cash Register Co., Dayton, Ohio Research Div.
RESEARCH AND INVESTIGATION OF CATHODOLUMINESCENT PHOSPHOR FILMS PREPARED BY SOLUTION SPRAYING Interim Engineering Report, 1 Oct. 1963–31 Mar. 1964

J. W. Gilliland and M. S. Hall May 1964 37 p refs
(Contract AF 33(657)-8985)
(IER-3; AD-441857)

The objective of this project is to determine the usefulness of the solution spray technique for deposition of phosphor films. Emphasis during this period was on the preparation of cathodoluminescent films emitting in the ultraviolet range of 250 to 350 nanometers and having high cathodoluminescent efficiency. A literature search yielded 122 different phosphor compositions reported to emit ultraviolet. A few of the more promising of these compositions were chosen for study. Lead-doped barium silicate and lead-doped strontium borate were the compositions explored most extensively. Sprayed films were prepared using a variety of composition ratios and heat treatment conditions. Instrumentation changes were made to permit the measurement of spectral emission and relative intensity in the UV region. Some of the sprayed $BaSi_2O_5$:Pb and $SrO{\cdot}4B_2O_3$:Pb films exhibited UV emission intensity that compared favorably with that of NBS standard powders. Work is continuing on increasing the intensity of UV emission from sprayed films. Author

N64-25356 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
SURVEY OF AEROSPACE REQUIREMENTS FOR BEARINGS AND LUBRICANTS
D. G. Flom May 1964 29 p refs
(R64SD38; AD-439892)

This is a survey of the requirements for bearings and lubricants by the aerospace industry. For convenience, the conditions are separated into natural environments associated with space and induced environments associated with specific vehicles and missions. Natural environments include low pressures, temperature extremes, meteoroid impact, electromagnetic and particulate radiation, and low gravitational forces. Temperature extremes, nuclear radiation effects, and acceleration, shock, and vibration loading make up induced environments. G.D.B.

N64-25399 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Final Engineering Report
30 Jun. 1964 49 p
(Contract DA-36-039-SC-86730)
(AD-601955)

These are process specifications to increase transistor reliability. Among the items specified are developing silicon slices, operating a dryer system, measuring silicon epitaxial resistivity, and the HCl etching of epitaxial substrates. G.D.B.

N64-25400 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Final Report, 1 May 1962–31 Oct. 1963
[1963] 59 p
(Contract DA-36-039-SC-86730)
(AD-601954)

Several process improvements and refinements were incorporated into the manufacturing cycle of the n-p-n silicon planar 2N744 transistor. Improvements were realized in the areas of epitaxial material, slice cleanliness prior to high temperature processing, control of both base and emitter diffusions, photo-resist pattern definition and control, control, package, and collector contacts. The device reliability level at the start of the contract was determined to be 4.2%/1,000 hr with a 90% confidence level. The program objective failure rate of 0.001%/1,000 hr at 5% of rated power has been met. The estimated failure rate with a 90% confidence limit at the end of the contract period was 0.00032%/1,000 hr. Author

N64-25403 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
QUALITY CONTROL MANUAL INSPECTION PROCEDURES FOR SILICON NPN PLANAR EPITAXIAL, DEVICE TYPE 2N744
15 Aug. 1963 280 p
(Contract DA-36-039-SC-86730)
(MPQRA 101A; AD-601958)

Inspection procedures for accomplishing the following objectives in regard to semiconductor components are discussed: (1) assurance that all products shipped meet the customer's requirements; (2) process, product, and reliability improvement; and (3) the development and maintenance of control techniques and test methods consistent with technological progress. I.v.L

N64-25408 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
SUMMARY OF THE SEVENTH REFRACTORY COMPOSITES WORKING GROUP MEETING, VOLUME III.
L. N. Hjelm, Darrell R. James, and C. S. Lee, comp. Nov. 1963 336 p refs
(RTD-TDR-63-4131; AD-601266)

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2. REFRACTORY DEVELOPMENTS FOR SPACE APPLICATIONS J. W. Graham (Astro Met Associates, Inc.) p 625–631 refs (See N64-25410 17-18)

3. ARC PLASMA SPRAYED TUNGSTEN AS AN ENGINEERING MATERIAL A. Eisenlohr (Arde-Portland, Inc.) p 633–638 refs (See N64-25411 17-18)

4. SPECIAL REPORT TO REFRACTORY COMPOSITES WORKING GROUP E. Olcott (Atlantic Res. Corp.) p 640–644 refs (See N64-25412 17-18)

5. COMPOSITE MATERIAL RESEARCH AT THE BOEING COMPANY F. H. Simpson (Boeing Co.) p 646–660 refs (See N64-25413 17-18)

6. HIGH TEMPERATURE OXIDATION RESISTANT COATINGS J. C. Withers (General Technol. Corp.) p 662–669 refs (See N64-25414 17-19)

7. BENCH SCALE STUDIES ON HIGH TEMPERATURE MATERIALS COMPATIBILITY R. H. Singleton (General Motors Corp.) p 671–677 refs (See N64-25415 17-18)

8. CURRENT RESEARCH ON REFRACTORY COMPOSITES AT THE MARTIN COMPANY, SPACE SYSTEMS DIVISION E. L. Strauss (Martin Co.) p 679–699 refs (See N64-25416 17-01)

9. NARMCO ACTIVITIES IN THE FIELD OF REFRACTORY COMPOSITE ATTACHMENTS R. A. Long (Telecomputing Corp.) p 701–716 refs (See N64-25417 17-18)

10. INVESTIGATION OF WHISKER-REINFORCED METALLIC COMPOSITES W. H. Sutton (General Electric Co.) p 718–727 refs (See N64-25418 17-18)

11. WHISKER MICROCOMPOSITES O. E. Accountius (Rocketdyne) p 729–762 refs (See N64-25419 17-01)

12. REPORT TO REFRACTORY COMPOSITES WORKING GROUP M. Headman (Western Gear Corp.) p 764–781 refs (See N64-25420 17-01)

13. PLASMA ARC SPRAYING FOR USE IN RADIATING ROCKET CHAMBERS N. A. Tiner and S. W. Pohl (Astropower, Inc.) p 783–802 refs (See N64-25421 17-18)

14. NEW TECHNIQUE FOR PLASMA SPRAYING TUNGSTEN H. S. Ingham, Jr., and F. N. Longo (Metco, Inc.) p 804–810 refs (See N64-25422 17-18)

15. HIGH TEMPERATURE REACTOR MATERIALS FABRICATION RESEARCH R. Van Houton (General Electric Co.) p 812–823 refs (See N64-25423 17-01)

16. MODIFICATION OF PLASMA FLAME IMPINGEMENT TESTER AND SOME PRELIMINARY TESTS OF FOUR COMPOSITE MATERIALS H. Hahn and S. Pan (Curtiss-Wright Corp.) p 825–868 refs (See N64-25424 17-19)

17. PLASMA TORCH OXIDATION RESISTANCE AND EROSION EVALUATION OF PYROLYTIC MATERIALS S. Sklarew and M. J. Albom (Marquardt Corp.) p 870–907 refs (See N64-25426 17-19)

18. DEVELOPMENT OF HEAT GENERATING SYSTEMS FOR ROKIDE FLAME-SPRAYING G. H. Lusher and W. M. Wheildon (Norton Co.) p 909–915 refs (See N64-25426 17-13)

19. HYPERTHERMAL RESEARCH FACILITY, PROGRESS REPORT NO. 3 J. E. Burroughs and R. A. Stevens (General Dynamics/Fort Worth) p 917–923 refs (See N64-25427 17-10)

N64-25410 Astro Met Associates, Inc., Cincinnati, Ohio

REFRACTORY DEVELOPMENTS FOR SPACE APPLICATIONS

J. W. Graham *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 625–631 (See N64-25408 17-01)

The report discusses the development of (1) high-purity aluminum oxide for reentry radar windows; (2) Amcer Mat. a modified aluminum titanate, as a thermal shock braze jigging material; (3) porous tungsten to be used for the emitter in ion propulsion; (4) nickel and Inconel foams with the following potential applications—reservoirs in the nongravity fields of space systems where liquids have to be contained for such purposes as field sources, heat exchange liquid reservoirs for power-generating systems, a soil capture structure for lunar exploratory vehicles, nondirectional impact-resistant cushions for space vehicles, and high-power rechargeable storage batteries; and (5) a highly thermal-shock-resistant zirconium dioxide foam. A new ablation-resistant epoxy composition has been impregnated into these zirconium dioxide foams. Also, the foams have been impregnated with phenolics or phenol silanes. These impregnated foams are being evaluated for rocket nozzle applications. I.v.L.

N64-25413 Boeing Co., Seattle, Wash.

COMPOSITE MATERIAL RESEARCH AT THE BOEING COMPANY

F. H. Simpson *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 646–660 (See N64-25408 17-01)

(Contract AF 33(616)-7815)

A metal (Inconel) honeycomb reinforced MgO system was developed, which is promising for superorbital glide reentry leading edges and for under surface panels in the temperature range of 3,500° F to 4,500° F. The Nb-Y_2O_3, Ta-Al_2O_3, Mo-HfO_2, and Mo-mullite systems were evaluated in the refractory metal–ceramic, macrolaminate composite program on the basis of their chemical compatibility at elevated temperatures, and of the similarity of the coefficients of thermal expansion of the oxide and metal phases. Specimens with an approximate 50–50 volume of metal-to-ceramic were fabricated and tested to compare room and 3,000° F temperature flexural strength, impact resistance, thermal shock resistance, and oxidation resistance. The Mo-HfO_2 system was selected for further development because of superior oxidation resistance, higher potential use temperature, and good thermal shock resistance. I.v.L.

N64-25416 Martin Co., Baltimore, Md.

CURRENT RESEARCH ON REFRACTORY COMPOSITES AT THE MARTIN COMPANY, SPACE SYSTEMS DIVISION

E. L. Strauss *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 679–699 refs (See N64-25408 17-01)

This report gives a brief description of three research programs dealing with refractory composites—brazed refractory metal honeycomb sandwich panels, resin-impregnated porous ceramics, and ablative ceramic composite structures. Processes were developed for the fabrication of brazed honeycomb sandwich panels using molybdenum and columbium core and facings. Resin-impregnated porous silica foams provided greater thermal insulation than impregnated zirconia or alumina foams when compared on an equal weight basis. Impregnation with a light cell wall coating of phenolic increased the strength of ceramic foams fourfold to eighfold, and a strengthening effect is still noted after the resinous cell wall coating has been pyrolyzed to a carbonaceous char. Analysis of heat shields for superorbital reentry revealed that a metallic or ceramic radiative shield, protected during the superorbital plunge by a surface ablative layer, provides the most efficient thermal protection. Author

N64-25417 Telecomputing Corp., San Diego, Calif.

NARMCO ACTIVITIES IN THE FIELD OF REFRACTORY COMPOSITE ATTACHMENTS

R. A. Long *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 701–716 (See N64-25408 17-01)

Activities in the field of refractory composite attachments are reviewed. Tensile data for tungsten-to-graphite bonding for applications to 5,000° F are presented. Room tensile strengths of 530 psi have been obtained with failure occurring completely within the graphite, and tensile strengths of 193 psi at 4,000° F have been obtained with failure occurring in the tungsten–vanadium brazing phase. A chemical bonding method involving the use of a protective metallic coating for the aluminum oxide and a braze alloy compatible with the refractory metal were developed, which will join radome-grade aluminum oxide (96%) to a refractory molybdenum alloy (TZM). The use of the Nb alloy F48, or possibly the newly developed Ta base alloys, would minimize expansion and contraction mismatch and give the designer more latitude in his joint design approach. Two different concepts for brazing refractory alloys, utilizing exothermic reactions, are being investigated. The first concept utilizes the heat from an exothermic reaction to melt a commercial braze alloy, the exotherm mixture being placed on the exterior of the joint. The second concept utilizes a reaction from an exotherm placed within the joint, which not only produces the heat for brazing, but also produces the braze alloy. I.v.L.

N64-25418 General Electric Co., Philadelphia, Pa.

INVESTIGATION OF WHISKER-REINFORCED METALLIC COMPOSITES

W. H. Sutton *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, vol. III Nov. 1963 p 718–727 refs (See N64-25408 17-01)

(Contract NOw-60-04655)

Investigations on the growth of α-Al_2O_3 whiskers by vapor phase reactions have resulted in significant improvements in the yield of needlelike whiskers having a high degree of surface

perfection. The α-$A1_2O_3$ whiskers maintain high-strength levels at temperatures approaching their melting point and, unlike E-glass fibers, show marked resistance to surface damage by abrasion or corrosion. Composite specimens were prepared by infiltrating molten silver into galss tubes containing whiskers packed to various densities. Prior to infiltration, the whiskers were first precoated with a thin, vapor-deposited metallic film of nickel or platinum to promote complete penetration by the molten silver. Results of tensile-strength tests on these specimens show that the composite strength increased with increasing whisker content. The addition of 30% whiskers increased the strength of unreinforced silver from about 22,000 psi to 160,000 psi. Furthermore, the average stress in the whiskers was calculated to be of the order of 750,000 psi, which demonstrates the fact that a relatively soft, ductile metal, such as silver, is capable of effectively transferring an applied load to the reinforcement (whiskers). I.v.L.

N64-25419 Rocketdyne, Canoga Park, Calif.
WHISKER MICROCOMPOSITES
O. E. Accountius *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 729–762 refs (See N64-25408 17-01)

The literature on reinforced high-temperature composite materials and filamentary crystals (whiskers) has been abstracted, and the appropriate portions are reported. Whiskers of the alkali metal halides and some metals were grown in the laboratory. Sapphire whiskers (α-Al_2O_3) were grown by the oxidation of aluminum using wet hydrogen in the temperature range 1,300° to 1,500° C. Author

N64-25420 Western Gear Corp., Lynwood, Calif.
REPORT TO REFRACTORY COMPOSITES WORKING GROUP
M. Headman *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 764–781 (See N64-25408 17-01)

Included in this report of developmental efforts in the plasma deposition field are photographs of free-standing shapes (tungsten crucibles 1/16 in. thick and approximately 2 in. long and of a tungsten heater element for an ion engine, consisting of eight concentric tubes 0.005 in. thick) achieved by spraying over a precision mandrel. Beryllium cylinders, stainless steel spheres, and various rocket-nozzle and tube configurations were fabricated. Graphic data are presented on (1) the effect of gun-to-work distance on the density and deposition efficiency of tungsten; (2) the oxide impurity content of beryllium in the as-received powder, as-sprayed, and as-sprayed and sintered conditions; (3) the density of as-sprayed and of as-sprayed and sintered beryllium; (4) the tensile properties of as-sprayed and of as-sprayed and sintered beryllium, molybdenum, and tungsten, the carbon and nitrogen impurities in molybdenum in the as-sprayed and in the as-sprayed and sintered conditions; (5) the oxygen, nitrogen, and carbon impurities in plasma-sprayed tungsten; and (6) the effect on density of sprayed tungsten after sintering in hydrogen and in a hydrogen and vacuum atmosphere. I.v.L.

N64-25421 Astropower, Inc., Costa Mesa, Calif.
PLASMA ARC SPRAYING FOR USE IN RADIATING ROCKET CHAMBERS
N. A. Tiner and S. W. Pohl *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 783–802 (See N64-25408 17-01)

Discussed is the development of small radiating thrust chambers for attitude-control liquid rocket engines. This report summarizes the work done on fabrication data of chambers by plasma arc spraying. Some of the variables associated with the fabrication technique were analyzed, and recommendations are made for future work. Author

N64-25422 Metco, Inc., Westbury, N.Y.
NEW TECHNIQUE FOR PLASMA SPRAYING TUNGSTEN
H. S. Ingham, Jr., and F. N. Longo *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 804–810 (See N64-25408 17-01)

Preliminary work has been underway for developing a new technique for the plasma flame spraying of tungsten without special inert conditions. The technique involves the use of CO_2 cooling. The CO_2 is obtained from a siphon tank of liquid CO_2. The liquid in the tank is under its own vapor pressure. When it is brought through a tube to the open atmosphere, a cold jet of CO_2 is produced. A special device attached to the plasma flame spray gun produces two such CO_2 jets alongside the plasma flame. The workpiece being sprayed is transversed so that one jet precedes the spray spot, and the second jet follows the spot. If a cylindrical substrate is to be cooled, the CO_2 cooling device is placed so that the jets are immediately above and below the impacting powder coming from the plasma. Preliminary results indicate that the use of the new technique allows spraying at higher temperatures without inert cover, while preventing the workpiece from overheating and oxidizing. The coatings sprayed by this technique have significantly higher density and tensile strength than coatings without this cooling, and finer cuts of powder can be sprayed. I.v.L.

N64-25426 Norton Co., Worcester, Mass.
DEVELOPMENT OF HEAT GENERATING SYSTEMS FOR ROKIDE FLAME-SPRAYING
G. H. Lusher and W. M. Wheildon *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III Nov. 1963 p 909–915 (See N64-24508 17-01)

Major effort has been directed toward improved rates of coating application and control of spray pattern via equipment development and spray material development for the ROKIDE process. A spraying system that is currently in field trial stages is schematically presented. This system shows a potential advantage of some 25% to 50% or more in rate of coating with full maintenance of coating quality. This experimental system does not premix the fuel gases as in normal practice, but brings the oxygen and acetylene separately and directly to the burning nozzle. The oxygen, which is not limited in allowable pressure, is used to inject the acetylene directly into the burning orifice. In addition to the equipment development, the makeup of the rods has proved to be of utmost importance in gaining desired characteristics. The proper chemical composition and geometry contribute greatly to achieving a good performance coating. One unique way of creating a composite coating by the ROKIDE process has been to coat a ceramic spray rod with a metal, then to spray the two-phase rod as though it were a single-phase rod. I.v.L.

N64-25484 Mechanical Technology, Inc., Latham, N.Y.
RESEARCH ON GAS LUBRICATION AT HIGH TEMPERATURES AND LOW FLOW RATES Technical Documentary Report, Mar. 1963–Mar. 1964
P. Lewis and J. Meacher Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 120 p refs
(Contract AF 33(657)-10694)
(APL-TDR-64-56; AD-601178)

This report describes the effort on a program that has as its objective the development of nitrogen gas lubricated journal and thrust bearings that have the best potential for stable operation at temperatures to 1,900° F and speeds to 60,000 rpm with low flow rates. The program concentrated

on attaining quantitative performance data on dynamic rotor bearing behavior. The report summarizes materials selection, bearing types, equipment design, instrumentation, and experimental work. Author

N64-25529 David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.
EXPLORATORY INVESTIGATION OF NONWELDED PRESSURE HULLS FOR HYDROSPACE VEHICLES
Arthur C. Macurdy Mar. 1964 24 p refs
(DTMB-1762; AD-439588)

The feasibility of fabricating a deep-submergence pressure hull composed of rings joined by means other than welding was explored in tests of three structural models (two of aluminum and one of titanium) designed for a collapse strength of 10,000 psi. These tests demonstrated that hulls can be built without welding and that these hulls can have collapse strengths comparable to monolithic hulls. Longitudinal strength, watertight integrity, and corrosion protection, which were not explored by these tests, can be provided by any of several mechanical techniques without compromising collapse strength. Author

N64-25531 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
FABRICATION OF A LIGHTWEIGHT PLASTIC MISSILE RADOME
Harvey Peritt and Merrill Eig Apr. 1964 23 p
(TM-1156; AD-439224)

Two filament-wound missile airframes were fabricated using a ratio of longitudinal to loop windings of 2 to 1. The only filament-winding machine at Picatinny is a lathe-type machine that cannot produce longitudinal windings. Therefore a system was devised whereby loop windings were wound on a large 10-in.-diam drum and subsequently cut into developed segments to produce longitudinal fibers. Author

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-24238 General Electric Co., Schenectady, N.Y. Research Lab.
AN INVESTIGATION OF THE NATURE OF STRUCTURAL DAMAGE IN METAL-FORMING PROCESSES Progress Report No. 5, 18 Feb.–17 Apr. 1964
H. C. Rogers, L. F. Coffin, Jr., and R. C. Leech Apr. 1964 4 p
(Contract NOw-63-0671-c)
(Rept.-64-GC-0272M; AD-436098)

Initial drawing experiments were carried out using hard-rolled and tough-pitch bus bar copper and aluminum alloys 6061, 2024, and 7075. Results were as follows: (1) It is difficult to produce detectable damage in a material as ductile as copper. (2) Aluminum and copper alloys can be made to draw successfully or to fracture, depending on drawing conditions. Also discussed is damage evaluation, density-change measurements, and the reduction of data. P.V.E.

N64-24246 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF THE ACADEMY OF SCIENCE USSR. DIVISION OF TECHNICAL SCIENCES Selected Articles
6 Dec. 1963 21 p refs Transl. into ENGLISH from Izv. AN SSSR, Otd. Tekhn. Nauk (Moscow), no. 3, 1958 p 113–119 (FTD-MT-63-199; AD-437626)

CONTENTS:

1. FATIGUE STRENGTH OF THE METAL POWDER ALLOYS, TUNGSTEN CARBIDE–COBALT G. S. Kreymer, I. I. Sidorin, and E. F. Tishchenkova p 1–13 refs (See N64-24247 17-18)
2. BETA-PHASE PROPERTIES OF SYSTEM NICKEL–ALUMINUM L. N. Guseva and B. I. Ovechkin p 14–17 refs (See N64-24248 17-18)

N64-24247 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FATIGUE STRENGTH OF THE METAL POWDER ALLOYS, TUNGSTEN CARBIDE–COBALT
G. S. Kreymer, I. I. Sidorin, and E. F. Tischenkova *In its* News of the Acad. of Sci. USSR. Div. of Tech. Sci. 6 Dec. 1963 p 1–13 refs (See N64-24246 17-18)

An analogy between the fatigue and static strength of tungsten carbide–cobalt alloys is drawn with respect to their dependence on the content of cobalt and the size of the grains, i.e., finally, on the thickness of cobalt intercalculations and, consequently, on their plasticity. J.L.D.

N64-24248 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
BETA-PHASE PROPERTIES OF SYSTEM NICKEL–ALUMINUM
L. N. Guseva and B. I. Overchkin *In its* News of the Acad. of Sci. USSR Div. of Tech. Sci. 6 Dec. 1963 p 1–7 refs (See N64-24246 17-18)

The hardness of nickel–aluminum alloys in the beta-phase region was investigated, using poured samples of alloyed electrolytic nickel and aluminum of 99.9% purity. The dependence of alloy hardness on composition is depicted graphically showing that the minimum hardness and electric resistance of alloys approximate those of stoichiometric compositions. With a small surplus of aluminum in a composition approximately up to 49 at. %, the properties of the alloys changed very little with increase of concentration of solid solution; with further decrease of nickel in alloys, a steep climb of the microhardness and electrical resistance curves was observed. These results indicate that hardness is determined not only by forces of interatomic binding in the crystal lattice but also by structural changes proceeding in the alloys during the process of plastic deformation. M.P.G.

N64-24252 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
AUTOMATIC WELDING Selected Articles
29 Mar. 1963 77 p refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 5, 1962 p 1–24, 57–63, 78–88
(FTD-TT-62-1247/1+2; AD-401592)

CONTENTS:

1. A DECATRON PROGRAMMING UNIT B. Ye. Paton, V. S. Gavrish, and Yu. S. Grodetskiy p 1–6 refs (See N64-24253 17-18)
2. WELDABILITY OF 30KhSNVFA HARDENING SHEET STEEL IN DOUBLE AND SINGLE-SIDED, DOUBLE-PASS ARGON-SHIELDED ARC WELDING p 7–13a refs (See N64-24254 11-18)

3. ALLOYING OF HEAT-RESISTING AUSTENITIC STEELS, ALLOYS AND WELDED SEAMS WITH BORON IN THE 0.3–1.5% RANGE B. I. Medovar, L. V. Chekotilo, V. A. Lutsyuk-Khudin, N. I. Pinchuk, and L. G. Puzrin p 14–26d refs (See N64-24255 17-18)

4. SPECIAL FEATURES OF ELECTRONIC HEATING IN WELDING N. A. Ol'shanskiy p 27–37b refs (See N64-24256 17-18)

5. INVESTIGATION OF DIFFUSION WELDING APPLICABLE TO ELECTROVACUUM APPARATUS I. V. Afanas'yev and A. F. Khudyshev p 38–48a refs (See N64-24257 17-18)

6. MOLTEN-SLAG ARCLESS ELECTRIC WELDING OR VT5-1 TITANIUM ALLOY S. M. Gurevich and V. P. Didkovskiy p 49–58a refs (See N64-24258 17-18)

7. PRESS WELDING OF ROLLED SECTIONS OF ALUMINUM MAGNESIUM ALLOYS A. I. Shestakov and A. A. Rossoshinskiy p 59–64a refs (See N64-24259 17-18)

N64-24253 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A DECATRON PROGRAMMING UNIT

B. Ye. Paton, V. S. Gavrish, and Yu. S. Grodetskiy *In its* Autom. Welding 29 Mar. 1963 p 1–6 refs (See N64-24252 17-18)

An apparatus was developed to record a program on a fixed punch card, and thus eliminated movable elements for program reading. The application of decatrons makes it possible to count time more reliably and to repeat a program immediately after completion of a given cycle. The circuit developed has a smaller number of tubes and differs from earlier circuits in having a simpler design. G.D.B.

N64-24254 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

WELDABILITY OF 30KhSNVFA HARDENING SHEET STEEL IN DOUBLE AND SINGLE SIDED, DOUBLE-PASS ARGON-SHIELDED ARC WELDING

S. L. Mandel'berg and V. G. Gordonnyy *In its* Autom. Welding 29 Mar. 1963 p 7–13a refs (See N64-24252 17-18)

This report presents the results of a comparative investigation of double-sided welding and a new technique of double-pass, one-side argon-shielded welding of type 30KhSNFVA steel in thicknesses of 1.5, 2.2, and 4.0 mm. G.D.B.

N64-24255 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ALLOYING OF HEAT-RESISTING AUSTENITIC STEELS, ALLOYS AND WELDED SEAMS WITH BORON IN THE 0.3–1.5% RANGE

B. I. Medovar, L. V. Chekotilo, V. A. Lutsyuk-Khudin, N. I. Pinchuk, and L. G. Puzrin *In its* Autom. Welding 29 Mar. 1963 p 14–26d refs (See N64-24252 17-18)

The alloying of austenitic steels and seams welded on these steels with boron allows an increase in the resistance of the seam metal to the formation of hot crystallization cracks, greatly eliminates the danger of the appearance of around-the-weld hot cracks on welding, and guarantees extremely high reliability in welded joints. Problems are solved with a substantial simultaneous increase in the heat resistance of austenitic steels and welded seams. G.D.B.

N64-24256 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SPECIAL FEATURES OF ELECTRONIC HEATING IN WELDING

N. A. Ol'shanskiy *In its* Autom. Welding 29 Mar. 1963 p 27–37b refs (See N64-24252 17-18)

The essential nature of the heating process in electron-beam welding is theoretically substantiated. The sequence of events in joint formation in welding of large thicknesses is pointed out. Applications of the electron beam are discussed. G.D.B.

N64-24257 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

INVESTIGATION OF DIFFUSION WELDING APPLICABLE TO ELECTROVACUUM APPARATUS

I. V. Afanas'yev and A. F. Khudyshev *In its* Autom. Welding 29 Mar. 1963 p 38–48a refs (See N64-24252 17-18)

Two semi-industrial installations were built for vacuum diffusion welding of metals and ceramics to metal. A procedure was developed for diffusion welding of certain metals employed in the design of electrovacuum equipment. The dependence of strength, vacuum tightness, and high-temperature corrosion resistance of welded joints upon the fundamental parameters of diffusion welding for copper and other metals were investigated. G.D.B.

N64-24258 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

MOLTEN-SLAG ARCLESS ELECTRIC WELDING OF VT5-1 TITANIUM ALLOY

S. M. Gurevich, V. P. Didkovskiy, and N. N. Tikhov *In its* Autom. Welding 29 Mar. 1963 p 49–58a refs (See N64-24252 17-18)

Large section components prepared from a titanium alloy were successfully welded by the molten-slag arcless electric welding method. In welding forged pieces with plate electrodes prepared from the titanium alloy, the welded joints are equally as strong as those of the base metal, with satisfactory plasticity and toughness of the joints. To improve welded joints prepared from extruded alloy sections, it was necessary to increase the plasticity and toughness of the blanks. Molten-slag arcless electric welding of different size rings from the titanium alloy was introduced into batch production. G.D.B.

N64-24259 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

PRESS WELDING OF ROLLED SECTIONS OF ALUMINUM-MAGNESIUM ALLOYS

A. I. Shestakov and A. A. Rossoshinskiy *In its* Autom. Welding 29 Mar. 1963 p 59–64a refs (See N64-24252 17-18)

Press welding of components composed of aluminum-magnesium alloys at the butt was established. Investigations disclosed the high quality of joints produced by press welding. G.D.B.

N64-24272 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ARTIFICIAL CARBON AS AN HYDROCHLORIC ACID-RESISTANT STRUCTURAL MATERIAL

Gyula Bolcs *In its* Corrosion Observer 25 Feb. 1964 p 23-26 (See N64-24266 17-07)

Artificial graphite can be used as a construction material for handling hydrogen chloride gas or solutions. In gas absorbers, in which the gas is absorbed in a thin film of water descending over plates, the use of graphite instead of stoneware for plates reduces the required apparatus volume and coolant flow, and thus increases the efficiency of the system. Hydrogen chloride burner chambers have also been built with graphite. D.E.W.

N64-24279 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

FORUM: CAN STEEL RUST IN REINFORCED CONCRETE?

Istvan Szilagyi *In its* Corrosion Observer 25 Feb. 1964 p 52–57 (See N64-24266 17-07)

A formalized debate is presented on the corrosion of reinforcing steel in concrete structures. It is concluded that, if normal specifications and standards are followed, the steel reinforcement will not corrode. D.E.W.

N64-24334 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center

A REVIEW OF AVAILABLE INFORMATION ON THE WELDING OF THICK TITANIUM PLATE IN THE USSR

H. W. Mishler 6 Mar. 1964 24 p refs

(Contract AF 33(615)-1121)

(DMIC-MEMO-188; AD-600976)

In the U.S.S.R., thick titanium plate is being welded by processes that normally are not considered for welding titanium in the U.S. These are submerged-arc and electroslag welding. Submerged-arc welding is used for joining titanium with thicknesses in the range of 0.08 to about 2 inches. For thicknesses over 2 inches, electroslag welding is used. Author

N64-24351 Air Force Systems Command, Wright-Patterson AFB, Ohio Research Technology Div.

THIRD MARAGING STEEL PROJECT REVIEW

R. M. Dunco Nov. 1963 599 p refs Papers Presented at the 3rd Maraging Steel Proj. Rev., Dayton, Ohio, 24–25 Jul. 1963

(RTD-TDR-63-4048; AD-430647)

CONTENTS:

1. THE PROPERTIES OF WELDED 18Ni-7Co-5Mo PLATE Z. P. Saperstein and B. V. Whiteson (Douglas Aircraft Co.) p 1–42 refs (See N64-22488 15-18)

2. ELECTRON BEAM WELDING OF ONE-HALF INCH THICK MARAGING STEEL W. D. Padian, A. Toy, and R. Robelotto (North American Aviation) p 43–71 refs (See N64-24352 17-18)

3. WELDING OF 18% Ni-Co-Mo MARAGING ALLOYS R. E. Travis and C. M. Adams, Jr. (Mass. Inst. of Tech.) p 73–94 refs (See N64-24353 17-18)

4. EVALUATION OF HIGH NICKEL MARAGING STEEL FOR APPLICATION IN LARGE BOOSTER MOTOR FABRICATION P. P. Crimmins (Aerojet-General Corp.) p 95–183 (See N64-24354 17-34)

5. PLANE STRAIN FRACTURE TOUGHNESS MEASUREMENTS OF SOLID BOOSTER CASE MATERIALS H. E. Romine (Naval Weapons Lab.) p 185–211 refs (See N64-24355 17-33)

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10. METALLURGICAL EVALUATION OF 18% NICKEL MARAGING STEEL (300 KSI STRENGTH LEVEL) A. Melville (Thiokol Chemical Corp.) p 327–368 (See N64-24359 17-18)

11. ANISOTROPY OF YOUNG'S MODULUS IN 18% NICKEL MARAGING STEELS R. E. Lewis (Lockheed Missiles & Space Co.) p 369–385 refs (See N64-24360 17-18)

12. FRACTURE TOUGHNESS IN PLATE THICKNESS OF 18% NICKEL MARAGING STEELS R. E. Lewis (Lockheed Missiles & Space Co.) p 387–405 refs (See N64-24361 17-18)

13. SOME MICROSTRUCTURAL ASPECTS OF MARAGING (250) STEEL IN RELATION TO STRENGTH AND TOUGHNESS G. E. Pellissier (U.S. Steel Corp.) p 407–437 refs (See N64-24362 17-18)

14. EVALUATION OF MARAGING STEELS AT THE ARMY MATERIALS RESEARCH AGENCY E. B. Kula and C. F. Hickey, Jr. (Army Materials Research Agency) p 440–455 (See N64-24363 17-18)

15. THE EFFECT OF UNIDIRECTIONAL SOLIDIFICATION OF THE PROPERTIES OF 25% NICKEL MARAGING STEEL D. F. Armiento (Frankford Arsenal) p 457–481 refs (See N64-24364 17-18)

16. EVALUATION OF 18Ni-Co-Mo (300), 9Ni-4Co AND SAE 4340 STEEL FORGINGS R. L. Jones (General Dynamics) p 438–501 refs (See N64-24365 17-18)

17. INVESTMENT CAST MARAGING STEEL BY THE MONOSHELL PROCESS R. J. Wilcox (Misco Precision Casting Company) p 503–526 refs (See N64-24366 17-17)

18. FRACTURE TOUGHNESS AND STRESS CORROSION TESTING OF HIGH STRENGTH STEELS R. A. Davis (Boeing Co.) p 528–535 (See N64-24367 17-33)

19. EVALUATION OF HIGH-STRENGTH LIGHT-WEIGHT LAMINATED PRESSURE VESSELS OF LAP-JOINT CONSTRUCTION G. Citrin (Republic Aviation Corp.) p 538–547 (See N64-24368 17-33)

20. 18Ni MARAGING STEEL IN ELEVATED TEMPERATURE AIR-FRAME DESIGN J. May (North American Aviation, Inc.) p 549–570 (See N64-24369 17-18)

21. SOME EFFECTS OF ANALYSIS ON THE TRANSVERSE MECHANICAL PROPERTIES OF MARAGING STEELS N. J. Culp and M. D. Sullivan (Carpenter Steel Co.) p 571–582 (See N64-24370 17-18)

22. MARAGING STEEL IN TWELVE POINT BOLTS J. T. Bingham (Hi-Shear Corp.) p 583–593 (See N64-24371 17-18)

N64-24352 North American Aviation, Inc., Los Angeles, Calif.

ELECTRON BEAM WELDING OF ONE-HALF INCH THICK MARAGING STEEL

W. D. Padian, A. Toy, and R. Robelotto *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 43–71 refs (See N64-24351 17-18)

Information is presented on electron beam welding of 250 and 200 grade maraging steel, including welding procedure development, mechanical property test data, and metallurgical evaluation of electron beam welded joints. This test program was conducted to determine procedures for satisfactory electron beam welds in 1/2-in.-thick maraging steel, for application to the construction of solid propellant rocket engine cases. D.E.W.

N64-24353 Massachusetts Inst. of Tech., Cambridge

WELDING OF 18% Ni-Co-Mo MARAGING ALLOYS

R. E. Travis and C. M. Adams, Jr. *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 73–94 refs (See N64-24351 17-18)

Weldments have been deposited on 18% Ni maraging steel ranging in thickness from 0.065 to 0.500 in. by the electron beam, permanent electrode, and consumable electrode process. The peak temperatures experienced during welding in the

heat-affected zone have been determined, and the darkly etching regions have been identified with specific peak temperatures and correlated with microhardness traverses. In addition, uniaxial and biaxial tensile strengths and joint efficiencies have been determined for various welding processes and heat treat cycles. Author

N64-24356 Mellon Inst., Pittsburgh, Pa.
EVALUATION OF MARAGING 18% NICKEL STEEL SHEET AND PLATE. PHYSICAL AND MECHANICAL PROPERTIES AND SOME FABRICATION CHARACTERISTICS
G. K. Bhat and W. J. Persin *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 275–301 (See N64-24351 17-18)

Tests on 18%-nickel maraging steel sheets and plates were carried out to determine fracture toughness and the effect of plastic zone size on fracture properties. Weldments in thick maraging steel plate sections were prepared by tungsten-arc–inert-gas and metal-arc–inert-gas welding techniques, and grain size was excessive. Under carefully controlled welding conditions a weld joint efficiency of about 86% can be obtained in 260-ksi-strength, maraging steel, thick plate sections. Small maraging steel pressure vessels are being tested under biaxial conditions and in the presence of surface notches. D.E.W.

N64-24359 Thiokol Chemical Corp., Brigham City, Utah Wasatch Div.
METALLURGICAL EVALUATION OF 18 PERCENT NICKEL MARAGING STEEL (300 KSI STRENGTH LEVEL)
Al Melville *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 327–368 (See N64-24351 17-18)

Three heats of 18% nickel maraging steel were used. Samples were subjected to flat tensile strength, center notch tensile, and partial thickness crack tests. A fracture toughness comparison was made with three other structural materials. Three 6-in.-diam 18% nickel steel bottles were pressure-tested to failure, and results are included. D.E.W.

N64-24360 Lockheed Missiles and Space Co., Palo Alto, Calif.
ANISOTROPY OF YOUNG'S MODULUS IN 18% NICKEL MARAGING STEEL
Richard E. Lewis *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 369–385 refs (See N64-24351 17-18)

Anisotropy in Young's modulus exists for all conditions studied. In the annealed condition, typical moduli are 25.8 and 27.6×10^6 psi, parallel and perpendicular, respectively, to the principal rolling direction. Either aging or re-solution treating plus aging raise the moduli from 1 to 2×10^6 psi. Cold working as much as 10% prior to aging or re-solution treating plus aging, has little influence on the modulus measured after aging. Cold working 60% followed by aging produces a modulus approximately 31×10^6 psi perpendicular to the rolling direction, 26×10^6 psi at 45°, and 27×10^6 psi parallel to the rolling direction. Re-solution treating after 60% cold work, followed by aging essentially removes the effect of cold working on modulus. Author

N64-24361 Lockheed Missiles and Space Co., Palo Alto, Calif.
FRACTURE TOUGHNESS IN PLATE THICKNESS OF 18% NICKEL MARAGING STEELS
Richard E. Lewis *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 387–405 refs (See N64-24351 17-18)

Fracture toughness of 200- and 250-grade 18% nickel maraging steel was investigated. Three thicknesses of the two grades were obtained and formed, aged in molten neutral salts, fatigue precracked, and impact tested. Conclusions related to directional differences in resistance to crack propagation, to crack propagation resistance in 200- and 250-grade steel, to specimen with influence, and to influence of fatigue crack depth on fracture toughness are given. D.E.W.

N64-24362 United States Steel Corp., Monroeville, Pa.
SOME MICROSTRUCTURAL ASPECTS OF MARAGING (250) STEEL IN RELATION TO STRENGTH AND TOUGHNESS
G. E. Pellissier *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 407–437 refs (See N64-24351 17-18)

Preliminary observations on microstructures in maraging (250) steel, as they relate to strength and toughness, are presented. Microstructure of austenitized and air-cooled steel; microstructure of austenitized and normally aged steel; overaging and reversion to austenite; banding, residual austenite, and microsegregation; and the effect of banding on fracture toughness were investigated, and observations are reported in tables, micrographs, and diagrams. D.E.W.

N64-24363 Army Materials Research Agency, Watertown, Mass.
EVALUATION OF MARAGING STEEL AT U.S. ARMY MATERIALS RESEARCH AGENCY
Eric B. Kula and Charles F. Hickey, Jr. *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 440–455 (See N64-24351 17-18)

The mechanical properties of 18% nickel maraging steel have been determined at temperatures from room temperature down to −269° C. This steel has poorer ductility and toughness at this low temperature than alloys designed for cryogenic applications, but better properties than other high-strength steels. The strain at maximum load is 0.01, which is very low. The variation of elongation in the tensile test with sheet thickness has been studied. The maraging steel shows a greater sensitivity to thickness than most other metals. Various thermomechanical treatments have been studied. The strength can be increased, although toughness is generally reduced by these treatments. There is an indication that mechanical properties are affected by an interrupted cooling from the annealing temperature and by reheating after maraging. Author

N64-24364 Frankford Arsenal, Philadelphia, Pa. Research and Development Group
THE EFFECT OF UNIDIRECTIONAL SOLIDIFICATION OF THE PROPERTIES OF 25 PERCENT NICKEL MARAGING STEEL
D. F. Armiento *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 457–481 refs (See N64-24351 17-18)

A method was devised for producing a casting or an ingot that shows essentially unidirectional solidification. Twenty-five-percent-nickel maraging steel was prepared in ingots in the normal manner and by unidirectional solidification, and was then aged. Samples were cut, further treated, and shaped for test. Standard strips were tested for tensile strength and fracture toughness. High tensile properties were obtained through high hardener contents, but fracture toughness was considerably reduced. Properties were somewhat dependent on grain orientation. D.E.W.

N64-24365 General Dynamics/Fort Worth, Tex.
EVALUATION OF 18 NiCoMo(300), 9Ni-4Co, H-11 AND SAE 4340 STEEL FORGINGS
Richard L. Jones *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 483–501 refs (See N64-24351 17-18)

This paper briefly presents the results of a year's testing on high-strength steel forgings that were being considered

for possible application as landing gear material. Primarily, the investigation was concerned with 18 NiCoMo(300) maraging steel and 9Ni-4Co Republic steel, although SAE 4340 and H-11 steels were also examined, to provide comparative data. Over 400 tensile specimens and 450 fatigue specimens were tested from nine large forgings and four billets of the four materials. Author

N64-24369 North American Aviation, Inc., Los Angeles, Calif. Design Producibility-Metals Unit
18Ni MARAGING STEEL IN ELEVATED TEMPERATURE AIRFRAME DESIGN
J.A. May *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 549–570 (See N64-24351 17-18)

Information presented was obtained from two heats of 3 1/2-in. by 7-in. bar stock. Data include longitudinal and transverse notched and unnotched tensile strength, compression yield strength, shear ultimate strength, bearing ultimate and yield strength for e/D = 1.5 and 2.0, axial-loaded fatigue S-N curves for smooth and notched bars, and 650° F creep data. Data on effects of strain rate, and on effects of long-time exposure on tensile properties are also included. Limited formability and weld data are presented, and problems associated with these processes are discussed. Author

N64-24370 Carpenter Steel Co., Reading, Pa.
SOME EFFECTS OF ANALYSIS ON THE TRANSVERSE MECHANICAL PROPERTIES OF MARAGING STEELS
N. J. Culp and M. D. Sullivan *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 571–582 (See N64-24351 17-18)

Realization of optimum properties of the maraging alloys requires very close control of residual elements. Smooth and notched tensile properties are not the only nor even the most important criteria for selection of high-strength materials.
D.E.W.

N64-24371 Hi-Shear Corp., Reading, Pa.
MARAGING STEEL IN TWELVE POINT BOLTS
John T. Bingham *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 583–593 (See N64-24351 17-18)

Tensile, shear, tension-tension fatigue, and stress-corrosion tests were performed on bolts and other samples of maraging steel of the 18-300 type. Macrostructure and microstructure were examined metallurgically. Results are presented in summary, tabular, graphical, and photographic forms. D.E.W.

N64-24386 Nuclear Metals, Inc., Concord, Mass.
REFRACTORY METAL CONSTITUTION DIAGRAMS Technical Report, Jan. 1962–Sep. 1963
V. Nerses, E. J. Rapperport, J. L. Klein, L. F. Pease, S. J. Michalik (MIT) et al Jan. 1964 300 p refs
(Contract AF 33(616)-7157)
(WADD-TR-60-132, Pt. 3; AD-600762)

Data on six binary constitution diagrams and four ternary constitution diagrams of some of the refractory metals are presented. The binary diagrams include Nb-Ru, Nb-Ir, Nb-Rh, Nb-Hf, Mo-Ir and W-Pd; the ternaries are Mo-Zr-Ti, Ta-W-Zr, W-Mo-Os, and W-Re-Hf. The quaternary Mo-Zr-Ti-C in the molybdenum rich region at low carbon contents ($\leq$1 wt.%) was superficially examined. Care was taken to obtain reliable diagrams. In particular, the purity of the elements (99.9% plus) was protected when possible, and the temperatures were measured to an accuracy of ±20° C. Author

N64-24505 Brush Beryllium Co., Cleveland, Ohio
DEVELOPMENT OF VERY HIGH STRENGTH BERYLLIUM WIRE Bimonthly Report No. 2, 6 Feb. 1964–6 Apr. 1964
E. A. Murphy and R. G. O'Rourke 6 Apr. 1964 13 p refs
(Contract NOw-64-0162-c)
(TR-351-243; AD-439498)

The results of work directed toward development of a process to produce high-strength beryllium fine wire are described. The extrusion data for −10 +1 (IP) and 0.4% Fe alloy are listed along with the known chemistry of the −10 +1 (IP) material. Warm drawing results of the −74 +1, −20 +1, −10 +1, and −5 +1 materials are discussed. Author

N64-24530 Joint Publications Research Service, Washington, D.C.
FATIGUE AND OXIDATION OF HIGH TEMPERATURE ALLOYS
28 May 1964 45 p refs Transl. into ENGLISH from Vopr. Fiz. Metal. i Metalloved., Akad. Nauk Ukr. SSR, Sb. Nauchn. Rabot. (Kiev), no. 17, 1963 p 98–137
(JPRS-24826; OTS-64-31362) OTS: $1.25

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1. STRUCTURE CHANGES DURING UNSTEADY HEATING OF NOZZLE VANES MADE FROM A CAST, NICKEL-BASE HEAT-RESISTING ALLOY V. N. Gridnev, A. I. Yefimov, N. P. Kushnareva, and M. S. Khazanov p 1–12 refs (See N64-24531 17-18)
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N64-24531 Joint Publications Research Service, Washington, D.C.
STRUCTURE CHANGES DURING UNSTEADY HEATING OF NOZZLE VANES MADE FROM A CAST, NICKEL-BASE HEAT-RESISTING ALLOY
V. N. Gridnev, A. I. Yefimov, N. P. Kushnareva, and M. S. Khazanov *In its* Fatigue and Oxidation of High-Temp. Alloys 28 May 1964 p 1–12 refs (See N64-24530 17-18) OTS: $1.25

Nozzle vanes that passed thermal fatigue tests on a dynamic-gas installation under conditions simulating starting and stopping of a gas turbine engine were subjected to thermal cycling. Microstructure and electron microscope investigations of cast and heat treated vanes indicated essential differences in their structure. In a heat-treated vane there was considerable dissolution of carbides as compared with cast vanes. The microstructure of vanes in the cracked region shows that fracture occurs primarily in the grain boundaries. R.T.K.

N64-24532 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF CRYSTAL STRUCTURE CHANGE DURING THERMAL FATIGUE OF ALLOY ZhS-6K
A. P. Glazov, L. I. Lysak, L. V. Tikhonov, and M. S. Khazanov *In its* Fatigue and Oxidation of High-Temp. Alloys 28 May 1964 p 13–21 refs (See N64-24530 17-18) OTS: $1.25

Significant changes of structure of alloy ZhS-6K nozzle vanes occur during thermal cycling. These changes occur in

the surface layers at depths of 0.05 mm to 0.10 mm. A noticeable change of microstresses and lattice parameter of the γ-phase occurs with a relatively small number of thermal cycles (approximately 100). The data indicate that during thermal cycling of vanes there is no noticeable accumulation of elastic macrodeformation and microdeformation in the surface layers when compared to the initial state of the alloy. Before formation of a crack, an intense accumulation of plastic strain is observed accompanied by an increase in dislocation density. R.T.K.

N64-24533 Joint Publications Research Service, Washington, D.C.
EFFECT OF UNSTEADY HEATING ON CHANGE OF MAGNETIC AND ELECTRICAL PROPERTIES OF ALLOY ZhS-6K
V. I. Borisova, I. Ya. Dekhtyar, E. G. Madatova, V. S. Mikhalenrov, R. G. Fedchenko et al *In its* Fatigue and Oxidation of High-Temp. Alloys 28 May 1964 p 22–34 refs (See N64-24530 17-18) OTS: $1.25

The following are discussed: (1) change of ZhS-6K alloy hardness and sample shape during thermal cycling; (2) relationship of electrical resistivity to the number of thermal cycles in ZhS-6K alloy; and (3) paramagnetic susceptibility of samples and vanes of ZhS-6K alloy during thermal cycling. R.T.K.

N64-24534 Joint Publications Research Service, Washingington, D.C.
STUDY OF THE DIFFUSION AND OXIDATION PROCESSES IN ALLOY ZhS-6K UNDER CONDITIONS OF THERMAL CYCLING
S. D. Gertsriken, I. Ya. Dekhtyar, L. M. Kumok, V. V. Pilipenko, and M. S. Khazanov *In its* Fatigue and Oxidation of High-Temp. Alloys 28 May 1964 p 35–42 refs (See N64-24530 17-18) OTS: $1.25

The following are discussed: (1) diffusion of chromium and nickel in ZhS-6K alloy by vacuum vaporization and radioactive isotope techniques; (2) isothermal oxidation of ZhS-6K alloy; and (3) oxidation of ZhS-6K alloy during cyclic annealing. R.T.K.

N64-24575 Los Alamos Scientific Lab., N. Mex.
FABRICATION AND EVALUATION OF POWDER-ROLLED TUNGSTEN-URANIUM DIOXIDE DISPERSIONS
T. J. Ready, W. V. Green, and H. D. Lewis 11 Jun. 1964 44 p refs
(Contract W-7405-ENG-36)
(LA-2485) OTS: $1.00

Investigation of the many interrelated variables affecting the precision powder-rolling of a refractory metal fuel element material has led to the successful preparation of tungsten-45 v/o UO_2 dispersion-alloy sheets. This report summarizes the conditions necessary for the production of the alloy strip and describes the details of the steps involved in the successful hot rolling of specimens taken from the powder-rolled strip. Preliminary creep-rupture test data are presented, and the strength of the alloy is compared to that of commercial tungsten rod. Author

N64-24582 Joint Publications Research Service, Washington, D.C.
CASTING PROPERTIES OF HEAT-RESISTING ALLOYS
5 Jun. 1964 62 p refs Transl. into ENGLISH of 3 Articles from Liteynyye Svoystva Zharoprochnykh Splavov (Moscow), no.224, 1963 p 97–112, 177–194, 195–202
(JPRS-24969; OTS-64-31426) OTS: $1.75

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1. PRIMARY CRYSTALLIZATION OF HEAT-RESISTING ALLOYS A. Ya. Ioffe p 1–24 refs (See N64-24583 17-18)
2. THE STRUCTURE AND THE PROPERTIES OF THIN WALL CASTINGS FROM THE HEAT-RESISTANT ALLOYS M. T. Bogdanov p 25–50 refs (See N64-24584 17-18)
3. EXPERIENCE IN THE PRODUCTION OF CAST TURBINE BLADES FROM HEAT-RESISTING ALLOYS K. P. Lebedev and M. N. Yefimova p 51–62 (See N64-24585 17-17)

N64-24583 Joint Publications Research Service, Washington, D.C.
PRIMARY CRYSTALLIZATION OF HEAT-RESISTING ALLOYS
A. Ya. Ioffe *In its* Casting Properties of Heat-Resisting Alloys 5 Jun. 1964 p 1–24 refs (See N64-24582 17-18) OTS: $1.75

The grain size in both iron-base and nickel-base heat-resistant alloys varies significantly as a function of the alloy composition, the duration of solidification, and the liquid state. The iron-base alloys containing 20% Cr, but containing no nickel, have a fine-grained structure and are free of the transcrystallization zone in castings of small section. The addition of nickel (60%) causes a continuous coarsening of the grain and the formation of a zone of columnar crystals in all sections. J.L.D.

N64-24584 Joint Publications Research Service, Washington, D.C.
THE STRUCTURE AND THE PROPERTIES OF THIN-WALL CASTINGS FROM THE HEAT-RESISTANT ALLOYS
M. T. Bogdanov *In its* Casting Properties of Heat-Resisting Alloys 5 Jun. 1964 p 25–50 refs (See N64-24582 17-18) OTS: $1.75

The present paper covers an investigation of the forming of cast gas turbine blades from heat-resistant alloys as a function of such technological casting conditions as the form, the form material and form heating, and the method of delivery of the metal. A concurrent study was made of the effect of the structure, density, gas content, and scaling on the mechanical properties of the casting at normal and elevated temperatures. Author

N64-24847 Frankford Arsenal, Philadelphia, Pa. Research and Development Group
LON-CYCLE FATIGUE CHARACTERISTICS OF ULTRAHIGH-STRENGTH STEELS
C. M. Carman and L. H. Mulherin Feb. 1964 55p refs
(R-1707; AD-601188)

Crack growth studies, using D6Ac steel, heat treated to 240,000-psi yield-strength level, are described. In these studies the crack tip driving force was held constant for each cycle. Plate thicknesses of 0.160 and 0.075 in. were investigated. In the thick plate behavior, which is exemplified by the 0.160-in. specimens, the plate thickness is substantially larger than the local plastic zone size at the advancing tip of the crack. The elastic constraint, therefore, dominates the rate of crack propagation. Because of the lower elastic constraint present in a 45° oblique shear fracture, the rate of crack propagation at a constant driving force is less than that for the cup-cone condition. In the thin plate behavior, the shear displacement on the "Y" axis dominates, rather than the elastic constraint. The 45° oblique shear type of fracture, therefore, results in a greater rate of crack extension because the vertical displacements are larger than for the cup-cone type of fracture. Author

N64-24874 National Carbon Co., Parma, Ohio
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXVII: STUDIES OF GRAPHITE DEPOSITED BY PYROLYTIC PROCESSES Technical Report, May 1960–May 1962
P. H. Higgs, R. L. Finicle, R. J. Bobka, E. J. Seldin, and K. J. Zeitsch Wright-Patterson AFB, Ohio, AF Materials Lab., May 1964 110 p
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXXVII; AD-601833)

Methods of depositing high-quality pyrolytic graphite are described with evidence as to the cause of conical growths and delaminations within the structure of the material. Results are presented on the use of hydrogen, helium, and argon as diluents, and on the use of chlorine as an additive in the pyrolytic process. The mean deposition rate is shown to be a function of hydrocarbon concentration, diluent type, gas velocity, temperature, and pressure. Theoretical studies of the equilibrium composition of methane as affected by changes in temperature and pressure are presented. Room-temperature pull strength of graphite yarn has been increased as much as 360 percent by reinforcement of the yarn with thin coatings of pyrolytic carbon; both single and multiple strand yarns have been coated. Author

N64-24904* Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE RESISTANCE OF MATERIALS IN LIQUID SODIUM
H. S. Preiser, A. Thiruvengadam, and C. Couchman, III N.Y., AIAA [1964] 8 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contract NASr-105)
(AIAA Paper-64-363) AIAA: $0.50 members, $1.00 nonmembers

Cavitation damage tests were conducted on 100A titanium up to 1,000° F, using a magnetostriction oscillator. Results indicate that (1) the rate of cavitation damage in liquid sodium is time dependent; (2) the rate of cavitation damage in the steady-state zone for liquid sodium varies as the second power of the displacement amplitude; (3) the rate of cavitation damage in the steady-state zone for liquid sodium increases with temperature up to a certain point and then decreases even though the temperature is higher (an increase in cavitation up to about 800° F and a decrease thereafter); (4) the intensity of cavitation in liquid sodium at 400° F is about 1 1/2 times that in water at 80° F for a given amplitude and frequency. Also, an attempt was made to estimate approximately the strain energy as a function of temperature, from published data, for pure iron, 201 nickel, 316 stainless steel, 600 Inconel, and 100A titanium, and to correlate this estimated strain energy with the rate of cavitation damage. Allowing for the inherent approximations, there is a correlation between the estimated strain energy and the cavitation damage resistance. I.v.L.

N64-24987 Marine Engineering Lab., Annapolis, Md.
LOW-CYCLE FATIGUE OF MATERIALS FOR SUBMARINE CONSTRUCTION Research and Development Report
M. R. Gross 14 Feb. 1963 56 p refs
(NAVENGRXSTA-91-197D; AD-601362)

Materials for submarine construction were investigated to determine their low-cycle flexural fatigue behavior. Both ferrous and nonferrous materials, including five steels with yield strengths of 40,000 to 230,000 psi, five nickel-base, six aluminum-base and three copper-base alloys were used in the study. Comparisons on the basis of three parameters—plastic-strain range, total-strain range, and nominal reversed stress—were made of the effects of mechanical notches, cycle pattern, weldments, and salt-water corrosion. It is concluded that the relationship between total-strain range and life is similar for all the materials investigated and that it offers a more general and practical approach to design than plastic-strain range or nominal reversed stress. Author

N64-25005* General Electric Co., Cincinnati, Ohio Missile and Space Div.
POTASSIUM CORROSION TEST LOOP DEVELOPMENT Quarterly Progress Report No. 3, Jan. 15–Apr. 15, 1964
E. E. Hoffman, Ed. [1964] 80 p refs
(Contract NAS3-2547)
(NASA-CR-54081) OTS: $7.60 ph

Research effort is reported in the following areas: (1) component evaluation Test Loop I (a natural convection loop); (2) component evaluation Test Loop II (a single-phase, forced-circulation loop—design and fabrication; (3) sodium for Loop II; (4) preprototype loop design; (5) airflow pressure-drop tests on boiler inserts; (6) preprototype loop fabrication and test chamber; (7) refluxing potassium compatibility tests; (8) material procurement; (9) grain-growth studies on Cb-1Zr; (10) helium analysis system; and (11) diffusion-bonding studies. R.T.K.

N64-25033 Belfour Engineering Co., Suttons Bay, Mich. Technical Information Systems
TITANIUM ALLOY 6A1-4V
Dec. 1963 7 p refs
(Sponsored by the Air Force)
(AD-437627) OTS: $1.10

Data in storage on titanium alloy 6A1-4V are presented in graphical form as a demonstration of possible uses of the information-retrieval system of the Mechanical Properties Data Center. It is intended merely to acquaint potential users with the amount and type of data available upon request. M.P.G.

N64-25042 Martin Co., Denver, Colo.
CRYOGENIC MATERIALS DATA HANDBOOK Progress Report No. 12
F. R. Schwartzberg, R. D. Keys, and S. H. Osgood Wright-Patterson AFB, Ohio, ASD, [1962] 106 p refs
(Contract AF 33(657)-9161)
(PB-171809-4; AD-437660)

Mechanical and physical properties are presented for the following cryogenic materials: aluminum; cobalt; copper; iron; nickel; titanium; carbides; nonmetals—ice, Kel-F, Mylar, nylon, and teflon; beryllium; and molybdenum. R.T.K.

N64-25052* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AXIAL-LOAD FATIGUE PROPERTIES OF PH 15-7 Mo STAINLESS STEEL IN CONDITION TH 1050 AT AMBIENT TEMPERATURE AND 500° F
Walter Illg and Claude B. Castle Washington NASA, Jul. 1964 25 p refs
(NASA-TN-D-2358) OTS: $0.75

Axial-load fatigue tests were conducted on notched and unnotched sheet specimens of PH 15-7 Mo stainless steel in Condition TH 1050. Fatigue lives at three mean stresses at ambient temperature (approx. 80° F) and at 500° F were determined throughout the lifetime range from 10^2 to 10^7 cycles. A special furnace incorporating guide plates is also described. A 500° F environment increased the fatigue limit but reduced the fatigue strength at short lifetimes. An effect of cyclic frequency was noted. Author

N64-25178 Army Missile Command, Huntsville, Ala. Propulsion Lab.

THE EFFECT OF SHEET THICKNESS ON THE TOUGHNESS OF 18-9-5 MARAGING STEEL

William S. Crownover and James W. Wright, Jr. 20 Mar. 1964 32 p refs

(RK-TR-64-8; AD-437809)

A study was made to determine the effect of sheet thickness on the toughness of an 18-9-5 maraging steel. To date, a large amount of data has been generated on the toughness of this type material, particularly in thicker sections; but very little has been accumulated for a range of sheet thicknesses. The material was examined in thicknesses ranging from 0.020 to 0.120 inch. To study the toughness of this material, the notched-to-smooth tensile test was used. Notch properties were obtained at room temperature and at −60° F. For this heat of steel, there is a noticeable degrading effect on the toughness at thicknesses of 0.080 inch or greater for three different maraging conditions. Low temperatures have only a slight degrading effect on the toughness of this material over the range of thicknesses examined. Author

N64-25197 Joint Publications Research Service, Washington, D.C.

INVESTIGATION OF SOME CASING ALLOYS FOR HIGH-PRECISION PARTS

M. L. Khenkin, N. K. Levina, S. I. Spektorova, V. I. Abramov, and V. G. Grishchenko 8 Jul. 1964 19 p refs Transl. into ENGLISH from Liteynoye Proizv. (Moscow), no. 3, Mar. 1964 p 27–31

(JPRS-25391; TT-64-31664) OTS: $0.50

Results are given of investigations concerning relaxations of stresses and stabilization of part dimensions of foundry AL2, AL9, VL15-1, ML5, and steel 35L, widely applied in instrument construction. The level of residual internal stresses was investigated on cast frame samples; deformation of samples were measured on a vertical optical indicator. Data from relaxation tests were analytically and graphically processed in semilogarithmic coordinates. All graphs and tables were constructed according to average arithmetical values of results of tests of not less than five samples. G.D.B.

N64-25222 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

TRANSITION FROM PLASTIC TO BRITTLE BEHAVIOR IN THIN TUNGSTEN WIRES

W. Schilling and H. Paschedag 10 Jun. 1964 12 p refs Transl. into ENGLISH from Metallwissenschaft und Technik (Germany), v. 14, no. 1, Jan. 1960 p 23–25

(RSIC-188; AD-602061)

A method for testing the behavior of thin tungsten wires at bending deformation is described. All tungsten wires show, within a narrow temperature range, the transition from brittle to ductile behavior. For wires with a fiber texture this transition temperature T_e is below 0° C; for recrystallized wires, at 150° to 400° C. Long-crystalline wires have a lower T_e than the short-crystalline ones. The position T_e is determined by the form of the fracture, transcrystalline or intercrystalline. Author

N64-25226 Titanium Metals Corp. of America, New York, N.Y.

DEVELOPMENT OF A STABLE-BETA TITANIUM ALLOY Sixth Quarter Report, 1 Oct.–31 Dec. 1963

D. B. Hunter [1963] 36 p refs

(Contract DA-30-069-ORD-3743)

(WAL-TR-405/2-5; AD-601825)

An attempt to induce compound precipitation hardening in Ti-17V-10Cr-3Al, Ti-8Mo-8V-7.5Fe-3Al, Ti-8Mo-8V-7.5Fe-sAl-1Co and Ti-15Mo-5Fe-3Al alloys by cold reduction and subsequent aging resulted in hardening by alpha precipitation instead. Similar work on Ti-17V-8Cr-3Al,-3Ni indicated that this alpha hardening was induced by either hot or cold rolling and suppressed by solution treatment. Solution treating, quenching and aging Ti-17V-10Cr-3Al, containing 0.5% and 1% Si, at 1,250° F resulted in rapid hardness increases of up to 100 Vickers points without any clear accompanying miscrostructural change; slow cooling suppressed this aging response. Aging responses were determined for the metastable alloys Ti-17V(1.5 to 4)Fe-3Al, and Ti-8Mo-8V-(1 to 3)Fe-3Al,. over a range of times and temperatures. A statistical correlation between Vickers hardness and ultimate tensile strength on stable-beta alloys indicated that 25 Vickers points corresponded to about 10,000 psi. Two metastable and two stable-beta alloys were selected for further evaluation as larger ingots: metastable Ti-17V-4Fe-3Al, and Ti-8Mo-8V-2Fe-3Al, and stable-beta Ti-17V-10Mn-3Al and Ti-8Mo-8V-6Fe-3Al,, respectively. Author

N64-25241 Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.

MECHANICAL PROPERTIES OF STRESS-RELIEVED STRETCHED ALUMINUM ALLOY PLATE Technical Documentary Report, Mar. 1962–Apr. 1964

G. W. Stickley and D. J. Brownhill Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 134 p refs

(Contract AF 33(657)-7837)

(ML-TDR-64-105; AD-602083)

The tensile, compressive, shear, and bearing properties were determined in the longitudinal and long-transverse directions for a total of 129 lots of commercially produced 2014, 2024, 7075, 7079, and 7178 plate in stress-relieved stretched tempers (−TX51), and in thicknesses from 0.250 to 6.000 in. For thicknesses larger than 2.000 in., tensile and compressive properties were determined in the short-transverse direction. Tests of 35 lots in heat-treated-by-user tempers were made. Ratios of tensile, compressive, shear, and bearing properties to corresponding long-transverse tensile properties were computed. Some variations in ratios occur with respect to alloy, temper, thickness, location in thickness, and direction of loading. Groups of ratios for each alloy in the −TX51 tempers were analyzed statistically. Minimum-average values were determined. Using these minimum-average values, together with long-transverse tensile properties from specifications as basis A values and corresponding basis B values obtained from recent production data, tables of design mechanical properties of MIL-HDBK-5 were prepared. Tensile and compressive stress-strain characteristics were determined. Typical and minimum stress–strain and compressive tangent-modulus curves were prepared for MIL-HDBK-5. Author

N64-25299 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.

AN APPROACH TO THE USE OF RADIOISOTOPES IN SALT SPRAY TESTING

C. G. C. White and E. F. Stevenson June 1964 16 p refs

(PA-TM-1271; AD-601667)

Salt spray testing is a general qualitative technique used to evaluate metal surface protective coatings. The conclusions drawn from such testing are at present arbitrary, since comparisons are made with standards that are sometimes not well defined and which depend upon individual judgment for determining conformity with specifications. Since salt spray testing simulates the effects of several types of corrosion, a wedding of the techniques used in measuring such corrosion with radioisotopic techniques might prove fruitful in making the salt spray test more quantitative. This report deals with the uses of radioisotopes

to study corrosion mechanisms, corrosion rates, surface phenomena, etc., and can provide a point of departure for launching an investigation into quantitative salt spray testing. Author

N64-25326 Rock Island Arsenal Lab., Ill.
WEIGHT LOSS OF PLATED METALS HEATED IN VACUUM
R. H. Wolff 24 Jan. 1964 25 p refs
(Rept.-64-233; AD-602409) OTS: $0.75

A series of experiments were conducted with 0.5 mil plated coatings on steel exposed to heat in vacuum. The plated coatings were cadmium, zinc, lead, nickel, and tin. Test conditions were exposure to vacuum at 1.5×10^{-5} torr and to temperatures from 200° to 675° F. Periodic weight change measurements were made in room atmosphere using an analytical balance. Only slight variations of weight were observed with tests of lead, nickel, and tin, and no significant losses under the conditions used. At their respective melting points, lead and tin softened, and the coatings coalesced to form drops at the edges of the specimens. Cadmium volatilized at rates of 3.0 to 7.6 mgm/cm^2/day for temperatures at 400° F. By reference to initial coating weights, the cadmium coatings were completely evaporated. Zinc coatings behaved in an unusual manner. An initial rate of weight loss occurred at 435° F, only to decrease to zero at 450° F with apparent constant weight. With increased temperature a rate of loss was resumed, and rates of 4.5 to 6.5 mgm/cm^2/day occurred at 550° F to a total loss of 90% coating weight. No further loss was observed through 675° F. By reference to initial coating weights, the zinc coatings were not completely evaporated. Plateaus of constant weight predominated at 450° F although shallow slopes were noted at 475° F. Weight losses at these points varied from 22% to 30% of initial coating. Another phenomenon observed was the formation of a powdery layer when specimens were started at test temperature of 450° F. When brushed, this powder accounted for approximately 11% of coating weight and although substantial zinc was still present, further test and brushing gave no more powder loss.
Author

N64-25329 Army Materials Research Agency, Watertown, Mass. Materials Testing Lab.
COMPARISON OF VARIOUS TEST SPECIMENS FOR THE DETERMINATION OF NOTCH SENSITIVITY AND FRACTURE TOUGHNESS OF HIGH-STRENGTH SHEET MATERIALS
Charles F. Hickey, Jr., and Frank R. Larson Feb 1964 21 p refs Previously Published as N64-17737 09-18)
(AMRA-TR-64-04; AD-601821) OTS: $0.50

A variety of test specimens and test methods are currently being used by several investigators to evaluate materials for space applications. In general, these tests are being conducted on high-strength sheet materials using specimens containing notches of one sort or another. The purpose of this program was to compare various test specimens for the determination of notch sensitivity and fracture toughness. Specimens considered were 1-in.-wide edge-notched, 1.5-in.-wide center-notched, and 3-in.-wide center-notched. Notch sensitivity data were obtained from all specimens; fracture-toughness data, based upon the ink stain and percent shear method, were gathered primarily from the 3-in.-wide specimen. Materials considered include AMS 6434, H11, 300M, and PH 15-7 molybdenum steels and 6A1-4V titanium. Two or more strength levels per alloy were investigated, and testing temperatures ranged from +165° to −80° F. Results of this investigation indicate that, of the designs considered, the 3-in.-wide specimen generally offers the best test to measure notch sensitivity or fracture toughness. Author

N64-25335 Naval Research Lab., Washington, D.C. Chemistry Div.
HIGH TEMPERATURE PROPERTIES OF SODIUM AND POTASSIUM Eleventh Progress Report, 1 Apr.–30 Jun. 1963
C. T. Ewing, J. P. Stone, J. R. Spann, E. W. Steinkuller, and R. R. Miller 13 Sep. 1963 6 p refs
(NRL-6004; AD-422904)

A program is in progress to measure various thermophysical properties of sodium, potassium, and their vapors at elevated temperatures. Preliminary results are presented for the saturated vapor pressure of potassium from 0.34 to 27.3 atm and the specific heat of the saturated liquid from 1,300° to 2,100° F. Pressure–volume–temperature data for the vapor states of potassium (temperature range from 1,573° to 2,520° F and pressure range from 2.3 to 24.3 atm) were obtained, and a thermodynamic treatment of the data is underway. Author

N64-25396 Auburn U., Ala.
K_{Ic} OF A 300-GRADE 18-NICKEL MARAGING STEEL AS INFLUENCED BY SPECIMEN TYPE AND THERMAL AND MECHANICAL TREATMENT. INVESTIGATION OF MECHANISM OF FAILURE OF HIGH-STRENGTH MATERIALS Final Report
Hal W. Maynor, Jr. and Courtney C. Busch 31 May 1964 44 p refs
(Contract DA-01-009-ORD-889)
(TR-3; AD-601537)

Three different type specimens were employed to determine the critical stress intensity parameter (K_{Ic}) under conditions of constant specimen thickness and varying yield strength (σ_{YS}). The magnitude of the parameter was observed to vary consistently, with one exception—specimen type. The parameter also was observed to be a discontinuous function of yield strength from the heat-treated-only, to the heat-treated-plus-cold-worked condition. The reason for the rather sharp drop in K_{Ic} for center-cracked relative to surface-cracked specimens, at σ_{YS} = 335 ksi, could not be explained. K_{Ic} of surface-cracked specimens was essentially independent of yield strength in the 297 to 335 ksi range. Author

N64-25409 Aerojet-General Corp., Sacramento, Calif.
PLASMA-ARC SPRAYED FREE-STANDING SHAPES FOR RADIATION-COOLED THRUST CHAMBERS
J. E. Bramer *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III, Nov. 1963 p 608–623 (See N64-25408 17-01)

Firing and vibration tests were conducted on a molybdenum rocket thrust chamber. Results indicate that radiation-cooled refractory metal thrust chambers, which are produced by the plasma-arc spraying of powders and the sintering of the free-standing shapes, are capable of withstanding thermal shock loading at subzero temperatures and vibratory loading at room temperature. The product to date is of a nonuniform nature.
I.v.L.

N64-25411 ARDE-Portland, Inc., Paramus, N.J.
ARC PLASMA SPRAYED TUNGSTEN AS AN ENGINEERING MATERIAL
A. Eisenlohr *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, vol. III, Nov. 1963 p 633–638 (See N64-25408 17-01)

Investigations were undertaken to produce high-density, high-purity, and high-strength tungsten deposits that could function in the as-sprayed condition and to determine the effects of subsequent thermal treatments on the properties of the

sprayed tungsten. The thermal treatments included vacuum sintering and isostatic gas compaction. The tungsten deposits are to be used as throat liners in rocket nozzles. The data obtained indicated that densities of 94% to 95% of the theoretical density of tungsten can be achieved in the as-sprayed condition. The tungsten contained 50 ppm of carbon, 80 ppm of oxygen, and 7 ppm of nitrogen. Tensile strength values of 30,000 lb/in.^{2} were obtained. Transverse rupture strengths ranged between 28,000 and 33,000 lb/in^2. A slight increase in density is obtained as a result of high-temperature vacuum sintering or by gas pressure compaction. However, a concomitant loss in room-temperature strength occurs. This is undoubtedly due to the massive grain growth that results from these densification treatments. I.v.L.

N64-25415 General Motors Corp., Indianapolis, Ind.
BENCH SCALE STUDIES IN HIGH TEMPERATURE MATERIALS COMPATIBILITY
R. H. Singleton and V. L. Hill *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III, Nov. 1963 p 671–677 (See N64-25408 17-01)

The study of short-time high-temperature reactions in refractory materials systems has continued. The systems investigated include the binary systems HfN-C and Ta-C and the ternary system W-HfN-C, in the temperature range 4,700° to 5,700° F. The carbon was present in the ternary system both as solid phase and as carbonaceous gases from ablating nylon. It was concluded that HfN is an effective reaction barrier in preventing tungsten eutectic melting in contact with carbonaceous materials for short times, 180 seconds, up to 5,400° F. Tantalum is almost as effective as a reaction barrier against carburization but its use is limited by its melting point, 5,400° F. Author

N64-25423 General Electric Co., Evandale, Ohio
HIGH TEMPERATURE REACTOR MATERIALS FABRICATION RESEARCH
R. Van Houton *In* AFSC, Summary of the 7th Refractory Composites Working Group Meeting. Vol. III, Nov. 1963 p 812–823 (See N64-25408 17-01)

A furnace was designed and constructed to obtain stress-rupture and creep data at temperatures up to 2,800° C in hydrogen and inert atmospheres. Stress-rupture data for Re, W-25Re, Ta, and Ta-10W sheet materials at 2,600° and 2,800° C were obtained for testing times up to 10 hours. Creep rates in hydrogen at 2,200°, 2,400°, and 2,600° C were determined for Mo, Ta, and Ta-10W. Stress-rupture tests on Mo at 2,200° C in hydrogen and argon have been conducted for 10- and 100-hour periods. A solid-state diffusion bonding procedure was developed for joining refractory metals. The procedure consists of maintaining intimate contact between the surfaces to be joined and of heating in vacuum (2×10^{-5} mm Hg) at elevated temperatures (1,370° to 2,200° C) depending on the material. Numerous applications (honeycombs, gas dividers, heat exchangers, etc.) are possible. One hundred-hour stress-rupture tests on all refractory metals are being conducted in hydrogen, argon, and neon at 2,200° and 2,800° C to confirm the predicted 100-hour stress-rupture life determined from the 10-hour tests. Solid-state bonding is being evaluated as a method of joining metal fuel elements. The development and evaluation of new refractory metal braze alloys is in process. I.v.L.

N64-25428 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBLEMS IN PHYSICS OF METALS AND METAL STUDIES Selected Articles
26 Mar. 1963 16 p refs Transl. into ENGLISH of 2 Articles from Vopr. Fiz. Metal. i Metalloved. (Kiev), no. 14, 1962 p 116–120, 147–151
(FTD-TT-63-48/1+2; AD-402431)

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1. EFFECT OF HEATING RATE ON THE TEMPERATURE INTERVALS OF CONVERSIONS DURING ELECTROANNEALING OF STEEL V. N. Gridnev and Yu. Ya. Meshkov p 1–6 refs (See N64-25429 17-18)

2. ON THE EXISTENCE OF MARTENSITE CRYSTAL FORMATION CENTERS ABOVE THE POINT OF METASTABLE EQUILIBRIUM I. A. Arbuzova and L. G. Khandros p 7–13 refs (See N64-25430 17-18)

N64-25429 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EFFECT OF HEATING RATE ON THE TEMPERATURE INTERVALS OF CONVERSIONS DURING ELECTROANNEALING OF STEEL
V. N. Gridnev and Yu. Ya. Meshkov *In its* Probl. in Phys. of Metals and Metal Studies 26 Mar. 1963 p 1–6 refs (See N64-25428 17–18)

The temperature ranges of steel annealing rise continuously in ratio to the rise in heating rate, whereby the range of decomposition of residual austenite rises considerably faster. In ratio to the increase in heating rate, the completeness of decomposition of residual austenite decreases. G.D.B.

N64-25430 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ON THE EXISTENCE OF MARTENSITE CRYSTAL FORMATION CENTERS ABOVE THE POINT OF METASTABLE EQUILIBRIUM
I. A. Arbuzova and L. G. Khandros *In its* Probl. in Phys. of Metals and Metal Studies 26 Mar. 1963 p 7–13 refs (See N64-25428 17–18)

This investigation makes an effort to clarify whether there are preferential points of nucleation in alloys not subjected to preliminary treatment. Cu-Sn (24.6%Sr) and Cu-Al-Ni (14.4%Al, 4.7%Ni) were the alloys selected in which martensite conversion is of reverse nature. It was possible to establish repeated conversion through the martensite point, when there are such points and when their activity is not lost during repeated conversion cycles. G.D.B.

N64-25464 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A PHENOMENON IN ALLOYS OPPOSITE TO AGING
G. I. Pogodin-Alekseyev 29 Apr. 1964 8 p Transl. into ENGLISH from Fiz. Metal. i Metalloved. (Sverdlovsk), v. 15, no. 5, 1963 p 793–795
(FTD-TT-64-124/1+2+4; AD-600814)

Two types of alloy aging are discussed: aging that is the decomposition of a supersaturated solution and aging that is the dissolution of the excess phase. The presence of the latter phase must be considered in establishing heat-treatment operations and cooling of the respective alloys, as well as in the subsequent utilization of articles made from these alloys, especially if they are used at high temperatures. I.v.L.

N64-25473 Little (Arthur D.) Inc., Cambridge, Mass.
THERMODYNAMIC AND KINETIC STUDIES FOR A REFRACTORY MATERIALS PROGRAM Technical Documentary Report, Jan. 1, 1963–Feb. 29, 1964

L. A. Mc Claine, ed. Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1964 237 p refs
(Contract AF 33(616)-7472)
(ASD-TDR-62-204, Pt. III; AD-601424)

Work presented includes preparation of borides and carbides; low-temperature heat-capacity measurements on HfB_2, HfC, and hafnium metal; estimation of entropies at 298° K for refractory diborides, nitrides, carbides, and oxides from high-temperature heat-content data; current status of heats of formation of the borides and carbides from oxygen and fluorine bomb calorimetry; and studies proving the feasibility of the "matrix isolation technique" for spectroscopy of high-temperature molecules through studies on the lithium halides. Status of electron diffraction, equilibria, and heat of solution studies of the hafnium and zirconium halides is presented. Kinetic studies completed on the oxidation and fluorination of the hafnium and zirconium carbides and diborides are presented in detail. From a.c. and d.c. electrical conductivity studies on tetragonal ZrO_2, a model of the defect structure is devised, and oxygen diffusion in ZrO_2 is calculated. Author

N64-25493* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
HARDENABILITY OF TITANIUM ALLOYS
L. D. Jaffe, E. Gordon, and F. W. Cotter Repr. from Trans. of the Met. Soc. of Aime, v. 230, Apr. 1964 11 p refs
(Contract NAS7-100)
(JPL-TR-32-589)

The hardening of titanium-base alloys was studied by metallographic examination and by hardness survey of Jominy specimens end-quenched from the β range. Analyses of the data led to the equation log J = −0.57 + 0.25 (pct Fe + pct Mn + pct Mo) + 0.19 (pct Cr) + 0.16 (pct V) + 0.03 (pct Zr). Here J is the distance, in sixteenths of an inch, from the quenched end of a Jominy specimen in the position of peak hardness, for material quenched from the β range. This equation fitted the experimental data with a standard deviation of approximately 0.29. The effects of the elements Al, Sn, W, Cu, Ni, B, C, N, O, and H, and of grain size, were not statistically significant or not practically significant. Author

N64-25500 Telecomputing Corp., San Diego, Calif. Narmco Research and Development Div.
SILICA FIBER FORMING AND CORE-SHEATH COMPOSITE FIBER DEVELOPMENT Final Summary Technical Report, 1 Jan.–31 Dec. 1963
W. H. Otto 31 Jan. 1964 69 p
(Contract N600(19)-59607)
(AD-438145)

Continuous fused quartz fiber forming was achieved from melts contained in both molybdenum and tungsten bushings operated in an argon atmosphere. Fiber-forming temperatures ranged from approximately 2,150° C to 2,300° C. Tungsten was superior to molybdenum as a bushing material. Fiber forming in helium atmosphere was unsuccessful. Fiber tensile strengths were widely scattered, with maximum values of 500,000 psi being achieved. An optimum tungsten bushing design had not yet been achieved, and the useful bushing life was 4 hours at the end of the program. Using a redraw method of fused quartz, Vycor, and Pyrex tubing charged with candidate core materials, the feasibility of the core-sheath fiber was demonstrated with cores of Al_2O_3, ZrO_2, and other high modulus polycrystalline materials. Modulus values higher than 20×10^6 psi and tensile strengths up to 200,000 psi were achieved. These studies showed that a dual melt system is required for continuous coresheath fiber forming. Author

N64-25506* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
PROPERTIES OF WELDED HIGH-STRENGTH TITANIUM ALLOY SHEET
A. J. Brothers, H. E. Martens, and H. L. Wood Repr. from Proc. of the Am. Soc. for Testing and Mater., v. 63, 1963 p 646–656
(Contract NAS7-100)
(NASA-CR-56787; JPL-TR-32-39(Rev. 1))

The high strength-to-weight ratios of currently available titanium alloys suggest their use as structural materials for spacecraft components. Six sheet alloys with a 0.2% yield strength of greater than 150,000 psi were welded with nine different filler wire alloys. A three-point combined free- and guided-bend test and a tension test were used to determine the properties of the weld joints. Weld joints made with low-alloy filler wires were more ductile than those made with higher alloy filler wire. Welding after aging resulted in higher ductility and lower strength values than welding prior to aging. On a relative weldability basis the alloys in decreasing order of weldability would be rated: 2.5Al-16V, B120VCA, 6Al-4V, 3Al-6Mo, 4Al-3Mo-1V, and RS140. Author

N64-25533 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
OXIDE TENACITY ON ALLOYS EXPOSED TO REACTOR COOLANTS
L. D. Perrigo Dec. 1963 19 p refs
(Contract AT(45-1)-1350)
(HW-79811) OTS: $0.50

Several tests to determine film tenacity and release of retained film radioactivity were made on various alloys that had been exposed to either neutral or high pH in-reactor loop water. Tenacity and film release characteristics were determined by changes in surface radioactivity levels of specimens that were contaminated but not irradiated. From tests with carbon steel and stainless steel exposed in a high pH water it was found that the total amount of radioactivity available for release was appreciably greater on carbon steel than on stainless steel. The same trend was true for both loosely adherent matter and material released by severe thermal shock. One test with Zircaloy-2 revealed that it had much more loosely adherent material and suffered greater thermal shock losses than the two steels. Its losses were about twice those of carbon steel, resulting in a surface radioactivity loss of 68%. Author

N64-25536 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
THE BEHAVIOR OF NOBLE METALS AND THEIR ALLOYS WITH OXYGEN AT HIGH TEMPERATURE IN THE SOLID STATE [UBER DAS VERHALTEN DER EDELMETALLE UND IHRER LEGIERUNGEN ZU SAUERSTOFF BEI HOHER TEMPERATUR IM FESTEN ZUSTAND]
Ernst Raub and Werner Plate London, Min. of Aviation, Apr. 1964 22 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 48, no. 10, 1957 p 529–539
(RAE-TRANS-1061)

Among the noble metals only solid gold does not show any noticeable reaction with oxygen (above the decomposition temperature of its oxide). Between 900° and 1,200° C platinum evaporates more easily in oxygen than rhodium and palladium; at 1,300° C this difference disappears. Characteristic surface structures are formed on noble metals and their alloys at high temperature in oxygen. When these are determined essentially by the lowering of the specific free surface energy caused by the oxygen-rich adsorption layer, and by the new crystals thus formed, then a distinct sharp surface profile may be observed, such as does not appear in normal etching or with heating in

other gases. If the influence of the volatilization of the noble metals with oxygen predominates in the formation of the new surface form, then typical etching formations are seen. Because the volatilization is increased at the crystallite boundaries, which show a heightened activity, the volatilization acts usually as a typical gain boundary etching. Author

N64-25574* Denver Research Inst., Colo.
THEORETICAL STUDIES ON THE RELATIONSHIPS BETWEEN THE THERMIONIC WORK FUNCTION OF REFRACTORY INTERMETALLIC COMPOUNDS AND THEIR ELECTRONIC AND CRYSTAL STRUCTURES Progress Report, 1 Jul.–31 Dec. 1963
C. Samuel Miller and Jerry D. Plunkett 19 Dec. 1963 3 p refs
(Grant NsG-365)
(NASA-CR-56907)

The current program status includes the following: (1) Arc melting and heat-treating techniques were developed in order to obtain the required single-phase specimens. A table is presented of four compounds, σ-phase Mo-Re, x-phase Mo-Re, σ-W-Re, and x-phase W-Re, indicating the compositions and the heat treatment necessary to obtain single-phase specimens from the arc-cast materials. (2) Several methods of specimen fabrication were investigated—a technique whereby an evacuated quartz capillary is plunged into the material in the arc melting process, powder metallurgy, and electroplating. Each method was rejected. Present thinking is directed toward two alternate techniques, namely, an electropolishing process utilizing 2% NaOH solution and high-current density or an electrophoretic deposition of the finely ground intermetallic compounds on 10-mil tungsten wire. I.v.L.

N64-25607 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
SOME APPLICATIONS TO NIOBIUM-ZIRCONIUM ALLOYS OF THE METHOD OF SPECTROGRAPHIC ANALYSIS OF SOLUTIONS ON CORED GRAPHITE [APPLICATIONS AUX ALLIAGES NIOBIUM-ZIRCONIUM DE LA METHODE D'ANALYSE SPECTROGRAPHIQUE DES SOLUTIONS SUR GRAPHITE A MECHE]
Frima Malamand Jun. 1964 28 p refs in FRENCH; ENGLISH summary
(ONERA-TN-76)

The principle of a new method of spectrographic analysis of solutions is described. A graphite electrode with a porous core in its center, previously submitted to outgassing, is impregnated during a known interval of time with the solution to be analyzed. Thus the core acts as a storage tank for the liquid, which feeds continuously the gap of the spark or of the arc. The effect of various factors on the emission of the lines from the solution elements and on the accuracy of the results is studied. By means of this method very accurate titration of zirconium in niobium–zirconium alloys is possible for a large concentration range (0.6% to 62%). Author

N64-25623 Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
STUDY OF SIZE EFFECT IN FINE BERYLLIUM WIRE, PHASE II
Paul J. Soltis 27 Mar. 1964 21 p refs
(NAEC-AML-1909; AD-438478)

Chemical milling procedures were developed that made it possible to produce beryllium wire in ultrafine sizes to slightly below 0.0010-in. diam without loss in strength, and that made it possible to determine whether a size effect exists in the wire. An evaluation of tension test data on the as-drawn wire indicates the following: (1) The 0.0046-in.-diam as-drawn beryllium wire can be chemically milled to sizes near 0.0010-in.-diam that show dimensional uniformity and good surface quality. (2) A continuous trend toward higher strength with decreasing diameter of the wire was noted, and it appears that ultrafine wire with strength approaching the 200,000 psi level can be produced with consistency. (3) A good degree of ductility was noted in wire chemically milled below 0.0025-in.-diam, as evident in necking of specimens, although this ductility did not appear in tensile elongation values. (4) Fracture strengths in wire showing ductile fractures reached values near 220,000 psi. I.v.L.

N64-25636 Naval Radiological Defense Lab. San Francisco, Calif.
TOTAL NORMAL AND TOTAL HEMISPHERICAL EMITTANCE OF POLISHED METALS, PART III Technical Report, 27 Feb.–19 Dec. 1962
G. L. Abbott Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1963 35 p refs
(Contract AF 33(657)-2-RD-155)
(WADD-TR-61-94 Pt. III; AD-436887)

The total hemispherical emittance, the total normal emittance, and the variation of electrical resistivity with temperature were measured on aged surfaces of tantalum, niobium, and tungsten in a vacuum over a temperature range from 1,000° to 3,000° K (subject to the material). In addition, the normal spectral emittance at 0.65μ was measured on tantalum and niobium. The total hemispherical emittance was obtained from the measured power dissipation within the uniform temperature region at the center of an electrically heated ribbon; its temperature was measured with a thermocouple or an optical pyrometer when the spectral emittance was known. The total normal emittance was determined by using a radiation thermopile. The ratio of total hemispherical to total normal emittance was also calculated directly from the angular distribution of radiation obtained by revolving the ribbon within the field of view of the thermopile. Author

N64-25666 Lockheed Missiles and Space Co., Sunnyvale, Calif.
BERYLLIUM: A SURVEY OF THE LITERATURE, JANUARY-JUNE 1963: AN ANNOTATED BIBLIOGRAPHY
Jack B. Goldmann, comp. Jul. 1963 81 p
(Contract NOrd-17017)
(SB-63-54; Rept.-3-80-63-5; AD-439444)

The following annotated bibliography covers publications released during the first 6 months of 1963. Citations are arranged alphabetically by author under broad subject headings of alloys; analysis; applications; bibliographies; compounds; corrosion; fabrication techniques; joining; metallurgy; oxides; powder metallurgy and casting; and processing and properties. References to the use of beryllium in fuels, nuclear reactor applications, effects of radiation, and the Cu-Be alloys have been omitted. Author

N64-25715 Los Alamos Scientific Lab., N. Mex.
THE GRAVIMETRIC DETERMINATION OF NICKEL IN URANIUM–NICKEL ALLOYS WITH DIMETHYLGLYOXIME
William H. Ashley, Ross D. Gardner, and Robert L. Carpenter 29 Jun. 1964 11 p refs
(Contract W-7405-ENG-36)
(LA-3088) OTS: $0.50

The gravimetric dimethylglyoxime method for the determination of nickel in uranium–nickel alloys was applied and critically evaluated over a wide concentration range. In this method the nickel is precipitated from a solution containing ammonium hydroxide and citric acid, after which the precipitate is dried for 1 hour at 115° C and weighed as nickel

dimethylglyoximate. The method gave excellent results when applied to alloys containing from 0.3 to 5.0 percent nickel. Fifty-two determinations on known solutions simulating uranium–nickel alloys in the above range showed an average recovery of 100.2% with a standard deviation of 0.5% relative for a single value. Author

N64-25720 Watervliet Arsenal, N.Y. Benét R & E Labs.
ELECTRODEPOSITION OF DISPERSION-STRENGTHENED GOLD-Al_2O_3-ALLOYS Technical Report
F. K. Sautter Dec. 1963 10 p refs
(WVT-RR-6321; AD-435622)

Gold–Al_2O_3 alloys were electrodeposited with Al_2O_3 contents up to 4.36% vol from electrolytes operating at pH values between 5.0 and 12.0. The dispersion of the Al_2O_3 in Au resulted in an appreciable decrease in the creep rate at 200° and 300° C. Resistivity measurements showed no change in resistivity compared to that for the pure metal. Author

N64-25764* Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DETERMINATION OF THE WELDABILITY AND ELEVATED TEMPERATURE STABILITY OF REFRACTORY METAL ALLOYS Third Quarterly Report, Dec. 21, 1963–Mar. 21, 1964
G. G. Lessmann and D. R. Stoner [1964] 89 p refs
(Contract NAS3-2540)
(NASA-CR-54088; WANL-PR-P-003) OTS: $8.10 ph

The electron beam welding effort was completed for FS-85 and Ta-10W. Tungsten inert gas (TIG) shielded arc welding was initiated for these alloys and for B-66, C-129Y, Nb-725, D-43, and SNb-291. Bend test results of the seven alloys mentioned are summarized. Restraint weld tests were completed for all available alloys (AS-55, B-66, C-129Y, Nb-752, D-43, FS-85, SNb-291, T-111, T-222, TA-10W, W-25Re, W, and Sylvania "A"). A double U-butt weld joint configuration was test welded for each alloy and was satisfactory for welding the 3/8-in. plate. TIG weld chamber tooling was installed and performed satisfactorily during initial weld tests. An evaluation was made of the effect of variation of vacuum pressure in the range of 10^{-3} to 10^{-5} torr on electron-beam weld contamination. Four ultra-high vacuum aging furnaces checked out at the factory and were delivered and installed. A list of 13 alloys that were ordered is presented. I.v.L.

N64-25766* Lockheed Missiles and Space Co., Sunnyvale, Calif.
CONVERSION COATINGS FOR ALUMINUM ALLOYS: AN ANNOTATED BIBLIOGRAPHY
Jack B. Goldmann, comp. Dec. 1963 32 p refs
(Contract NAS8-5600)
(NASA-CR-56317; SB-63-82; Rept.-8-30-63-6)

The chemical conversion coatings with which this annotated bibliography is concerned include chromate, phosphate, and oxide processes. Author

N64-25816 Iowa State U. of Science and Tech., Ames Ames Lab.
PRELIMINARY STUDY OF THE OPTICAL CONSTANTS OF SILVER CADMIUM ALLOYS NEAR 300 mμ
R. G. Dorothy and D. W. Lynch May 1964 22 p refs
(Contract W-7405-ENG-82)
(IS-863) OTS: $0.50

The room temperature optical constants of several silver–cadmium alloys (0% to 12.5% Cd) were measured by Avery's method in the wavelength region 290 to 335 mμ. The observed changes of the real and imaginary parts of the dielectric constant, $\epsilon = \epsilon_1 + \epsilon_2 i$ and of the plasmon loss function, $-\mathrm{Im}(\epsilon^{-1})$, are interpreted qualitatively. The interband transition at ~ 3.9ev has a state on the Fermi surface for its final state, in agreement with the assignment of Philipp and Ehrenreich. The shift in the plasma frequency upon alloying can be interpreted qualitatively as due to an increase in electron concentration, the interband contribution to the dielectric constant at the plasma frequency being roughly independent of alloying. The shortening of relaxation time for plasmons upon alloying is evident. Quantitative interpretation requires better data, obtained with some degree of control over surface conditions, over a wider wavelength range than is studied here. Author

N64-25833 Bureau of Mines, Washington, D.C.
PREPARATION OF COPPER POWDER FROM LEACH SOLUTIONS AFTER PRECIPITATION WITH IRON
R. D. Groves [1964] 27 p refs
(BM-RI-6486)

Laboratory research has demonstrated that high-grade copper powders can be produced under controlled conditions from cement copper products. The technique should enable small producers to prepare a directly marketable product by means other than smelting and electrolytic purification. A continuous drum-type precipitator was the preferred unit for producing fine-sized particles of cement copper that were further processed by chemical digestion in a copper sulfate solution, by reduction and sintering in a hydrogen atmosphere, and by grinding to a powder. The effects of variables related to all stages of the process were investigated. Treatment of leach solutions from three different sources resulted in copper powders containing 99.2% to 99.8% Cu, apparent densities of 1.97 to 2.25 grams/cu cm, good powder flow rates, and a size distribution of 54.9% to 60.1% minus 325-mesh material. Author

N64-25834 Bureau of Mines, Washington, D.C.
COLUMBIUM–HAFNIUM EQUILIBRIUM DIAGRAM
R. E. Siemens, H. R. Babitzke, and H. Kato [1964] 15 p refs
(BM-RI-6492)

An investigation was made to provide further information for evaluating columbium–hafnium alloys for use as high-temperature structural materials. The columbium–hafnium system was investigated between 700° and 2,400° C by melting point, thermal analysis, X-ray diffraction, electrical resistivity, and metallographic techniques. The equilibrium diagram is the beta isomorphous type, with columbium tending to stabilize the beta phase. Addition of 60 at.% columbium stabilizes the beta phase at 700° C. The allotropic transformation temperature of hafnium is 1,750° ± 20° C. A minimum melting point occurs near 75 at.% hafnium. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-24242 General Electric Co., Philadelphia, Pa. Missile and Space Div.
MECHANICAL PROPERTIES OF PYROLYTIC GRAPHITE
J. J. Gebhardt and J. M. Berry Apr. 1964 37 p refs
(R64SD26; AD-437144)

A series of mechanical strength and thermal expansion tests were carried out from room temperature to 5,000° F on the two microstructural types of pyrolytic graphite in current production. The present series of tests shows pyrolytic graphite to have an ultimate tensile strength of 18,000 ±2,000 psi at room temperature, rather than the previously found values of 11,000 ±5,000 psi. The largest difference between surface nucleated and continuously nucleated material was obtained in torsional tests parallel to the planes; values of 1,555 ±60 and 2,880 ±265 psi were obtained, respectively, throughout the temperature range to 5,000° F.. J.L.D.

N64-24273 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RESISTANCE TO HYDROCHLORIC ACID OF FIRED ENAMELS
Karoly Dullien *In its* Corrosion Observer 25 Feb. 1964 p 26–28 (See N64-24266 17-07)

Leaching of enamels by aqueous hydrochloric acid solutions is discussed. Among the general rules presented are the following: (1) The amount of leached components increases in an essentially linear manner with time of exposure. (2) Leaching during the first 1 or 2 hours is much greater than the average. (3) The leaching rate increases drastically with rising temperature. (4) Concentration effects with hydrochloric acid are negligible. D.E.W.

N64-24274 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PAINTS IN THE PROTECTION AGAINST CORROSION IN HYDROCHLORIC ACID ATMOSPHERES
Alfonz Mayer *In its* Corrosion Observer 25 Feb. 1964 p 28–30 (See N64-24266 17-07)

Corrosive effects of hydrochloric-acid-containing atmospheres on metals and lime mortar are described. Because of the inertness of paints to acid attack, the problem of protection reduces to surface preparation and coating application. Plastic dispersions and "chlor-caoutchouc" binder preparations are discussed for application to mortar and concrete. The cleaning and priming of metal surfaces are described. Bitumen coatings have proved unsatisfactory, as have most outdoor and bridge paints. General cleaning and painting hints are included. D.E.W.

N64-24276 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NONMETALLIC STRUCTURAL MATERIALS IN THE PROTECTION AGAINST CORROSION BY HYDROCHLORIC ACID
Rezso Moldvai, Martha Batori, and Oscar Knapp *In its* Corrosion Observer 25 Feb. 1964 p 33–39 (See N64-24266 17-07)

An outline description of production methods used in manufacturing these materials and a summary of some physical and chemical characteristics of the finished products are given. Protective structural materials discussed include fine and rough industrial ceramic products, glass, crystalline artificial stone (basalt abroad, but remelted slag locally), natural stones, and phenolic–resin impregnated wood. Synthetic plastics are increasingly supplanting and replacing these materials. D.E.W.

N64-24333 Picatinny Arsenal, Dover, N.J. Plastics Technical Evaluation Center
SUBJECT INDEX, BIBLIOGRAPHY, AND CODE DESCRIPTION OF TECHNICAL CONFERENCE PAPERS ON PLASTICS: 10 FEBRUARY 1962–10 FEBRUARY 1963
Arnold E. Molzon Aug. 1963 108 p refs
(PLASTEC-14; AD-423560) OTS: $2.50

The papers presented at the technical conferences on plastic materials and related technology, within a 1-year period ending 10 February 1963, have been listed and indexed by subject. Over 500 papers from 22 conferences are covered. This report serves as a guide to the subjects presented, and by means of a numerical code system, it tells the reader what type of information each article contains. Included are a bibliography and lists of references on plastic materials and technical data. Author

N64-24936 General Electric Co., Philadelphia, Pa. Missile and Space Div.
ULTRAVIOLET DEGRADATION OF ORGANIC MATERIALS
R. N. Griffin Feb. 1963 24 p refs
(R63SD15; AD-439836)

Equipment for the quantitative study of the photolysis of materials has been constructed and calibrated. The photolytic degradation of five organic compounds has been measured. From these results it is concluded that the addition of electronegative groups should increase the photolytic stability of polymers containing aromatic groupings. Author

N64-24949 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME XXXII: STUDIES OF BINDER SYSTEMS FOR GRAPHITE Technical Report, Sep. 1961–Dec. 1962
T. Edstrom, I. C. Lewis, R. L. Racicot, and C. F. Stout Wright-Patterson AFB, Ohio, Materials Lab., May 1964 53 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. XXXII; AD-601754)

Binder systems were investigated with respect to their thermosetting characteristics both to replace pitch-sulfur combinations presently used in the pressure-curing process and to provide binders for development of new graphite grades. The binder system included prepolymerized furfural-alcohol resin; pitch, furfural, furfuryl–alcohol combinations; pitch with a ferric chloride catalyst; and pitch with oxidizers such as inorganic persulfates, chlorates, and oxides. Acenaphthylene pitch, a new binder, was investigated with regard to thermosetting properties when used in the pressure-curing process. The binder modifications or systems investigated have produced no outstanding advantages over the pitch–sulfur system for use in the pressure-curing process. Author

N64-25124* National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab.
REVIEW OF STATIC SEALS FOR CRYOGENIC SYSTEMS
R. F. Robbins and P. R. Ludtke Repr. from J. of Spacecraft and Rockets, v. 1, no. 3, May–Jun. 1964 p 253–259 refs
(Sponsored by NASA)

Although cryogenic techniques have advanced rapidly, little effort has been devoted to standardization of seals for cryogenic systems. This paper surveys and evaluates various demountable, low-temperature static seals. Rectangular-sectioned gaskets of Teflon or Kel-F, or of soft metal, or with plastic sealing surfaces can be used, but gaskets require heavy flanges. O-rings of rubber, Viton, and neoprene have been used successfully down to 20° K with high-initial-loading designs. Hollow, metallic

O-rings can be used, but they are hard and require good surface finishes, ≥ 16 rms. Solid O-rings of soft metals (e.g., indium, lead, copper, and aluminum) can seal to 10^{-5} atm-cc/sec/linear-in. Pressure-actuated seals of C, U, V, or W configuration are said to be superior to all others for cryogenic space systems (a table of available types is given); they use lightweight flanges and will follow flange deflections; they are expensive, and small leak paths can develop, but they have proved reliable in the field. Temperature-actuated seals (favorable thermal contraction relationships) also show promise but have not been used extensively. Author

N64-25341 Stanford Research Inst., Menlo Park, Calif.
TENSILE STRENGTH OF BRITTLE MATERIALS Technical Documentary Report, 15 Jan. 1963–15 Jan. 1964
R. Sedlacek Wright-Patterson AFB, Ohio, Materials Lab., Mar. 1964 30 p refs
(Contract AF 33(657)-10600)
(ML-TDR-64-49; AD-601127)

The tensile strength of a commercial, high-alumina body was investigated by using hydraulically expanded cylindrical test specimens. Results were evaluated with respect to loading rate, surface finish, and microstructure. At various loading rates, uniform tensile strength data (coefficients of variation of less than 7.6%) were obtained in testing groups of specimens having the same fabrication history, while the differences in tensile strength between individual groups of specimens gave a measure of the overall extent to which uncontrollable fabrication variables affect the tensile strength of alumina bodies. Author

N64-25365 Southern Research Inst., Birmingham, Ala.
THE DEVELOPMENT AND EVALUATION OF HEAT-RESISTANT, RAIN-EROSION-RESISTANT COATINGS Bimonthly Progress Report, 26 Dec. 1963–26 Feb. 1964
R. B. Perkins 16 Apr. 1964 15 p refs
(Contract N-156-43450)
(BMPR 4; AD-439492)

Different lots of Viton A coating materials differ in the rate of curing, but all lots evaluated produce coatings of substantially equal properties if the coatings are cured for at least 30 days. Pyre-ML (pyromellitimide polymer) coatings were found to be unsatisfactory as rain-erosion-resistant coatings because of low abrasion resistance. One silicon–nitrogen polymer coating has been evaluated, and the preliminary findings encourage a further study of this type of polymer. A survey of the literature on heat-resistant polymers has indicated several types of polymers that are of interest for investigation for use in rain-erosion-resistant coatings. Author

N64-25412 Atlantic Research Corp., Alexandria, Va.
SPECIAL REPORT TO REFRACTORY COMPOSITES WORKING GROUP
E. Olcott *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III, Nov. 1963 p 640–644 (See N64-25408 17-01)

Firing tests were conducted with three different aluminized propellants, which span the range of flame temperature and oxidation ratio found in most advanced propellant formulations, namely: (1) 5,600° F flame temperature, 1.0 oxidation ratio; (2) 6,000° F flame temperature, 1.20 oxidation ratio, and (3) 6,500° F flame temperature, 1.08 oxidation ratio. Firing test results show that the order of listing of the above propellants is in the order of increasing erosion severity on pyrolytic graphite nozzles. This fact indicates that the propellant flame temperature has a greater effect on the performance of pyrolytic graphite nozzles than the oxidation rate. For each propellant, the erosion rate is strongly affected by the motor pressure. The results of subscale nozzle tests of motor-pressure effect are summarized graphically. The equations of each of the straight lines placed through the graphical data are as follows: for the 5,600° F propellant, erosion rate, mil/sec = 5×10^{-4} (P_c = 850) for the 6,000° F propellant, erosion rate, mil/sec = 9×10^{-4} (P_c = 620); and for the 6,500° F propellant, erosion rate, mil/sec = 9×10^{-4} (P_c = 300), where P_c is the average motor chamber pressure in psi. The graphical data represent the most complete set of control tests on pyrolytic graphite nozzles published to date. The erosion rates obtained are acceptable for most nozzle applications. I.v.L.

N64-25414 General Technologies Corp., Alexandria, Va.
HIGH TEMPERATURE OXIDATION RESISTANT COATINGS
J. C. Withers *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III, Nov. 1963 p 662–669 (See N64-25408 17-01)

The following methods of depositing high-temperature oxidation-resistant coatings are discussed: (1) vacuum pack cementation; (2) fluid bed using three different bed designs wherein the design variations involved the method of dispersing the fluidized gas over the bed area; (any of the refractory metals are readily silicided by iodide transport); and (3) disproportionation in fused salt. In the latter a mixture of sodium chloride and 20 mole % $TiCl_2$ served as the deposition melt. If the titanium is in the divalent state, it will deposit on any of the refractory metals and on nickel by simple immersion in the fused salt at about 1,800° to 1,900° F. Also, the concept of oxidation-resistant coatings with a diffusion barrier is discussed. I.v.L.

N64-25424 Curtiss-Wright Corp., Wood-Ridge, N.J.
MODIFICATION OF PLASMA FLAME IMPINGEMENT TESTER AND SOME PRELIMINARY TESTS OF FOUR COMPOSITE MATERIALS
H. Hahn and S. Pan *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III, Nov. 1963 p 825–868 (See N64-25408 17-01)

An available plasma-jet materials-testing apparatus has been modified and utilized in preliminary evaluation of four composite materials considered for application in rocket engine components. This apparatus includes a plasma gun, calorimeter, pressure probe, and positioning devices. Several electrode configurations have been evaluated, the most successful of which, in terms of conversion efficiency and durability, have been made of pyrolytic graphite. The apparatus, using nonwater cooled ring electrodes, is capable of operation for 70 minutes with a heat flux of 4,000 Btu/ft^2/sec at a probe pressure of 19 psi. Four materials including asbestos–nylon-filled phenolic (Tayloron 5031), silica-fiber-filled phenolic (Fibrite MX 5700), carbon-cloth mineral-filled phenolic (Fibrite MX 4551), and silica Macro Balloon asbestos (Fibrite MX 2625) were flame impingement tested and evaluated in terms of thermal erosion resistance, relative insulating properties, and other general characteristics. Author

N64-25425 Marquardt Corp., Van Nuys, Calif.
PLASMA TORCH OXIDATION RESISTANCE AND EROSION EVALUATION OF PYROLYTIC MATERIALS

S. Sklarew and M. J. Albom *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. III, Nov. 1963 p 870–907 (See N64-25408 17-01)

Pyrolytically derived materials selected for possible use in a free standing liquid-propellant rocket thrust chamber were subjected to the effluent of plasma arc heater, which simulated in its composition the combustion products of selected liquid propellants. A principal constituent of this effluent was water vapor (ranging as high as 30%) produced by second-stage injection of oxygen into a stabilized nitrogen–hydrogen plasma. Sample coupons of various pyrolytically derived materials were placed in the arc stream. This report notes the thermal, chemical, and physical effects produced on the test items and compares the materials with each other as candidate materials of construction for the free standing thrust chamber. Author

N64-25451 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

NEWS IN THE SYNTHESIS OF ORGANO-ELEMENTARY HIGH MOLECULAR COMPOUNDS

V. V. Korshak 4 Apr. 1963 27 p refs Transl. into ENGLISH from Zh. Uses. Khim. Obshch. (USSR), v. 7, no. 2, 1962 p 122–131

(FTD-TT-63-121/1+2; AD-402584)

The synthesis of heterochain organic polymers, which appears to be based on polycondensation, is reviewed, and the synthesis of the following polymers is discussed: (1) organic polymers containing elements of periodic group I—copper, potassium, and lithium; (2) organic polymers containing elements of periodic group II—beryllium and mercury; (3) organic polymers containing elements of periodic group III—boron–phosphorus; boron, aluminum, and thallium; (4) organic polymers containing elements of periodic group IV—silicon–fluorine, silicon–nitrogen, silicon–phosphorus, silicon, silicon–boron, tin, titanium, germanium, and lead; (5) polymers containing elements of periodic group V—phosphorus, phosphorus–boron, arsenic, antimony; and (6) polymers containing elements of periodic group VII—fluorine, fluorine–iodine, and fluorine–chlorine. I.v.L.

N64-25466 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A NEW METHOD FOR THE SYNTHESIS OF POLYPRAZOLES

V. V. Korshak, Ye. S. Krongauss, and A. M. Berlin 29 Apr. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 152, no. 5, 1963 p 1108–1110

(FTD-TT-64-218/1+2+4; AD-600815)

A new method has been developed for the synthesis of polymers that contain alternating pyrazole rings with a free NH-group of the pyrazole nucleus attached to the chains. The essence of this method is the interaction of bisdiazo compounds (e.g., 1,6-bis-diazohexane) with n-diethylbenzene or diacetylene. The synthesized polymers are yellow powders that are highly soluble in dimethylformamide and cresol. Their reduced viscosity in a 0.5% solution in cresol is 0.2 to 0.3, and their molecular weight is ~ 10,000. These polymers may be considered to be carbon chain polymers, since the basic polymer chain is constructed only from carbon atoms. I.v.L.

N64-25467 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE VAPOR PRESSURE OF ZIRCONIUM TETRAFLUORIDE

P. A. Akishin, V. I. Belousov, and L. N. Sidorov 28 Apr. 1964 8 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 8, no. 6, 1963 p 1520–1522

(FTD-TT-64-219/1+2+4; AD-600788)

This report discussed the measurement of the vapor pressure of zirconium tetrafluoride by means of an MS-4 spectrometer. When determining the vapor pressure by this method, notice must be taken of the gradual drop in vapor pressure in the effusion chamber, at a constant temperature, during the evaporation of the last portion of the substance. Since the mass spectrum makes it possible to record the curve of the vapor pressure drop, the experimental errors connected with this process (vapor pressure drop) do not exceed 2% and the error in weighing a 3- to 5-mg sample does not exceed 3%, taking into account the inaccuracy arising as a result of the presence of zirconium oxyfluoride. (The sample was an admixture of zirconium tetrafluoride and zirconium oxyfluoride.) The error in temperature measurement does not exceed 0.2%. The accuracy of the measurement of the effusion orifice area is about 20% and, if necessary, it can be raised substantially. Therefore, the error in the determination of the absolute vapor pressure does not exceed 30%. Also, the heat of sublimation of zirconium tetrafluoride was determined from the temperature dependence of the ion current density. I.v.L.

N64-25468 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A STUDY OF THE KINETICS OF THERMAL DECOMPOSITION OF SOLID CARBONYL COMPOUNDS OF METALS

O. D. Krichevskaya, N. A. Belozerskiy, L. D. Segal', N. E. Kolobova, K. N. Arisimov et al 28 Apr. 1964 7 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 8, no. 8, 1963 p 1806–1808

(FTD-TT-64-220/1+2+4; AD-600816)

The thermal decomposition reaction of solid molybdenum carbonyl and manganese cyclopentadienyltricarbonyl was studied on a special manometric apparatus—both reactions were of the first order. Constants of the reaction velocity and the activation energy were calculated. G.D.B.

N64-25469 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

STUDY OF THE ORIENTATION OF HIGHLY ORDERED REGIONS IN STRENGTHENED POLYVINYL ALCOHOL FIBERS

G. N. Afans'yeva, L. A. Vol'f, A. I. Meos, A. I. Slutsker, and S. Ya. Frenkel 28 Apr. 1964 10 p refs Transl. into ENGLISH from Zh. Prikl. Khim. (Moscow), v. 36, no. 7, 1963 p 1587–1591

(FTD-TT-64-319/1+2+4; AD-600780)

X-ray analyses of polyvinyl alcohol fibers were conducted by two methods: the photographic method and the ionization recording of X-ray diffraction. Types of fibers analyzed were: (1) fibers strengthened by high-temperature extrusion; (2) freshly formed fibers; (3) fibers not subjected to any kind of additional processing; and (4) fibers acetalized with formaldehyde by the usual production method. In addition, a corded polyvinyl alcohol fiber of foreign manufacture was analyzed as a reference sample. Results clearly show that the structural changes that took place in the fiber during its thermoplastic extrusion led to a significant increase in the orientation of the crystallites and also in their strength. At the same time, the data obtained make it possible to exclude the mechanism of strengthening, which is linked with dehydration, thus showing that the formation of intrachain cross links (acetalized fiber) leads to a lowering of the degree of ordering when compared to freshly formed fibers. I.v.L.

N64-25471 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

LATHANUM, SAMARIUM, AND EUROPIUM ORTHOTANTALATES

Ye. I. Krylov and M. M. Pinayeva-Strelina 12 May 1964 9 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 8, no. 10, 1963 p 2254–2257
(FTD-TT-64-221/1+4; AD-601550)

Orthotantalates of lanthanum, samarium, and europium were synthesized for the first time. Differential thermal analysis of the oxide mixture La_2O_3: Ta_2O_5 = 1:1 was carried out. X-ray diffraction pictures of $LaTaO_4$, $SmTaO_4$, $EuTaO_4$ powders were indexed. The pycnometric densities of these powders at 20° C were determined. Magnetic susceptibility was measured at 78.194 and 298° K. $LaTaO_4$ is diamagnetic, whereas $SmTaO_4$ and $EuTaO_4$ are paramagnetic. G.D.B.

N64-25485 Materials Research Corp., Orangeburg, N.Y.

THE ROLE OF THE GRAIN BOUNDARY IN THE DEFORMATION OF CERAMIC MATERIALS Technical Documentary Report, 1 Mar. 1963–1 Mar. 1964

G. T. Murray and R. A. Burn Wright-Patterson AFB, Ohio, AF Mater. Lab., Mar. 1964 46 p refs
(Contract AF 33(616)-7961)
(ASD-TDR-62-225, Pt. III; AD-601395)

The effect of solute additions on the deformation and fracture behavior of KCl bicrystals has been investigated. This material exhibited a definite transition from brittle to ductile fracture, the brittle type being of an intergranular nature and the ductile a "necked" matrix failure. This transition temperature was about 175° C for the high-purity specimens and 400–C for tilt misoriented calcium-doped (~100 ppm) bicrystals. Calcium-doped twist boundary bicrystals showed intergranular brittle fracture at temperatures as high as 600° C, which was the highest test temperature examined. It was found that wavy glide rather than the planar type was a prerequisite for ductile behavior and that the role of the solute was to suppress the onset of wavy glide, thus elevating the transition temperature. The data also showed a greater propensity for grain boundary sliding in the doped material in the tests that were conducted above the transition temperature. Author

N64-25579 National Carbon Co., Parma, Ohio

RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS VOLUME XXX — OXIDATION RESISTANT GRAPHITE BASE COMPOSITES

R. J. Zeitsch and J. M. Criscione Union Carbide Corp., Lawrenceburg, Tenn. Aug. 1963 80 p
(Contract AF 33(616)-6915)
(WADD-TR-61-72; AD-600340)

This report describes certain graphite-base composites capable of resisting oxidation by forming a protective coating from their oxidation products. When first exposed to oxidizing conditions, the additives or graphite-additive reactants oxidize and form a coating that protects the composite against further oxidation. Since these materials are homogeneous composites, they can be machined without destroying their oxidation resistant characteristics. The most effective additives investigated were combinations of ZrB_2, Si, B, Cb, and Th. All materials were prepared in a one-step operation by hot pressing. The report describes the equipment required to fabricate graphite-refractory composites by hot pressing at temperatures up to 3,400° C. Oxidation test methods employ indirect induction heating, resistance heating, arc image techniques, and electromagnetic levitation. Author

N64-25586 Little (Arthur D.) Inc., Cambridge, Mass.

GEOMETRY OF THE TRANSITION METAL DIHALIDES: THE FLUORIDES OF MANGANESE, COBALT, NICKEL, COPPER, AND ZINC Interim Technical Report No. 6

Alfred Büchler, James L. Stauffer, and William Klemperer (Harvard U.) 30 Apr. 1964 12 p refs
(Contract DA-19-020-ORD-5584; ARPA Order 40-62)
(ITR-6; AD-445941)

The deflection of mass spectrometrically detected beams of CaF_2, MnF_2, $MnCl_2$, CoF_2, NiF_2, CuF_2, ZnF_2, $ZnCl_2$, and $HgCl_2$ by an inhomogeneous electric field has been examined. As found previously, CaF_2 deflects in the manner expected for a polar molecule. The remaining molecules listed were found to be nonpolar. These observations are interpreted to imply that while CaF_2 has a nonlinear equilibrium geometry the remaining species are linear. The result for $HgCl_2$ is in agreement with a number of previous electron diffraction and spectroscopic studies. Author

N64-25610 Lockheed Missiles and Space Co., Sunnyvale, Calif.

EQUILIBRIUM OCCUPATION NUMBERS AND SPECIES CONCENTRATIONS FOR AIR, NITROGEN, AND OXYGEN TO 24,000° K Technical Report; Physics

B. H. Armstrong and M. Scheibe Jun. 1964 177 p refs
(Rept.-6-74-64-33)

Calculations of the compositon of air, nitrogen, and oxygen have been carried out. Occupation numbers for atomic states in pure nitrogen and oxygen are given in 1,000° K intervals for the temperature range from 10,000° to 24,000° K. Species concentrations of air constituents are tabulated over this temperature range. Tables of occupation numbers for the atomic and molecular states of pure nitrogen and oxygen, which cover the range from 3,000° to 10,000° K, are also included. Author

N64-25627 McDonnell Aircraft Corp., St. Louis, Mo.

PHYSICAL PROPERTIES OF NON-METALLIC MATERIALS FOR MANNED SPACE VEHICLES

M. E. Pickaux and Howard Spruill 29 Jan. 1964 34 p
(Rept.-6792)

The maximum use temperatures that have been established for nonmetallic materials to be used in the inhabited area of spacecraft are presented. The indicated temperature limits are based upon laboratory tests using 100% oxygen atmosphere at 5 psi absolute for 3 to 24 hours continuously, without producing irritating or obnoxious odors. The charts are guides for design engineers concerned with the selection for nonmetallic or nonceramic materials. Also included are reports on the contaminants recovered from capsule atmosphere of Mercury flights, and fabrication and housekeeping policies applicable to Models 133 and 133P capsules. R.T.K.

N64-25672 Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.

CHARACTERIZATION OF CELLOPHANE AS AN IONIC BARRIER

Claudia C. Evans May 1964 22 p refs
(NOLTR-63-225; AD-437997)

A literature survey has been conducted on the characteristics of cellophane as related to electrochemical cell barrier applications. The physical or chemical bonding of ions in electrolyte solutions to molecules in the membrane, or the catalytic complexing of undesirable ions, appears to be much more important in the effective operation of cellophane as a barrier than the filtering or capillary diffusion actions, although these latter actions cannot be ignored. Author

N64-25673 Solar, San Diego, Calif.
EXPLORATION AND EVALUATION OF NEW GLASSES IN FIBER FORM Final Report No. 2, 1 Jan.–31 Dec. 1963
Gunther K. Schmitz 25 Mar. 1964 107 p refs
(Contract Nonr-3654(00)(X))
(RDR-1343-6; TM-239; AD-434808)

Tensile strength measurements on Virgin E- and S-glass were achieved at approximately the same gage lengths previously used for fibers from E- and S-glass strands. The resulting strength–length curves were similar in shape to the strand fiber curves, indicating that mixed flaw populations were present also on freshly drawn fibers, but to varying degrees, depending on drawing conditions. Analysis of the corresponding failure probability plots provided detailed information on the characteristics of the different types of flaws, as well as on the proportional amounts present at the various fiber lengths. The existence of mixed flaw populations limits the application of single exponent failure probability functions, such as the Weibull, to certain gage lengths. Resistance to mechanical damage was found to be similar for the two glasses, and it was concluded that surface defects due to stranding were similar with respect to both severity and density. Author

N64-25683* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
KINETICS OF GRAPHITIZATION OF A PETROLEUM COKE
P. B. Fischbach Repr. from Nature, v. 200, no. 4913, 28 Dec. 1963 p 1281–1283 refs
(Contract NAS7-100)
(NASA-CR-56970; JPL-TR-32570)

The material investigated was a petroleum coke that had been baked approximately 15 min at 2,000° C. It had a turbostatic structure with a unit cell height, c, ~6.86 A and a crystallite diameter, $L\alpha$, of ~150 A. The progress of the graphitization was followed by X-ray diffraction measurements at room temperature as a function of isothermal heat-treatment time. The c value was determined from the position of the (004) diffraction peak using the Debye–Scherer technique with copper Kα-radiation. Powder samples were treated in graphite crucibles in a graphite-tube resistance furnace at 2,300° C, 2,500° C, and 2,700° C in helium at 1 atm. The results are presented in the form of graphs. R.T.K.

N64-25685 General Electric Co., Evendale, Ohio Advanced Engine and Technology Dept.
INFLUENCE OF STRESS CORROSION ON STRENGTH OF GLASS FIBERS First Bi-monthly Progress Report
D. L. Hollinger 20 May 1964 19 p ref
(Contract Nonr-4486(00))
(AD-601344)

This study is concerned with the effects of stress corrosion reactions involving water vapor from the atmosphere or from whatever other sources are available to the reacting species in the glass. The principal experimental technique is a systematic investigation of static fatigue, or delayed failure, or single virgin fibers in tension under various environmental conditions. R.T.K.

N64-25692 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
EVALUATION OF DOPED PERCHLORATES IN EXPERIMENTAL PHOTOFLASH COMPOSITIONS
David J. Edelman and Seymour M. Kaye Oct. 1963 23 p refs
(TM-1091; AD-426005)

The effects of an oxidant containing added impurities such as Ag^+, Cu^{++}, and I^- ions upon the luminosity of flash systems were tested in the following blends: (1) FP600 (60/40 potassium perchlorate–aluminum) photoflash composition for sea level applications; (2) FP790 (30/20/50 calcium–aluminum–potassium perchlorate) photoflash composition for high-altitude applications; and (3) FP856 (31/20/49 aluminum–calcium fluoride–potassium perchlorate) high-altitude flash composition. All tests were performed at sea level or at 20.9-mm Hg, simulating 80,000 feet altitude, and at the temperature prevailing at the Pyrotechnic Laboratory High Altitude Tank. Author

N64-25725 Georgia Inst. of Tech., Atlanta Engineering Experiment Station
CERAMIC SYSTEMS FOR MISSILE STRUCTURAL APPLICATIONS Quarterly Report, 1 Nov. 1962–31 Jan. 1963
N. E. Poulos, S. R. Elkins, C. A. Murphy, and J. D. Walton 31 Jan. 1963 41 p ref
(Contract NOw-63-0143-d)
(QR-1; AD-298985)

The current program status includes the following: (1) Radomes of type "C" and modified type "C" were fabricated by pressure casting fused silicon dioxide slip at a pressure of 20 psig and then firing the dried radomes at 2,200° F for 4 hours. The radomes were of the flame-glazed and unglazed types. (2) Flame-glazing parameters were established for surface flame-glazing of both the type "C" and the modified type "C." Difficulty in boiling of the glaze in the tip area of the modified type "C" radomes was overcome by deflecting the arc-plasma flame with a programed, controlled air jet directed normal to the flame. (3) New work was initiated for improving the strength and thermal properties of slip-cast fused silicon dioxide. I.v.L.

N64-25742 Columbia U., New York, N.Y. Plasma Lab.
DE-ACTIVATION OF NEON METASTABLES BY H_2 Report no. 8
Thomas C. Marshall Jan. 1964 67 p refs
(Grant AF-AFOSR-48-63; Contract Nonr-266(93))
(AFOSR-64-0571, AD-436178)

Measurements are reported of the total cross section for deactivation of neon $^3P_2$ and $^3P_0(2p^53s)$ metastables by inelastic collisions with H_2. Measurements were made by applying the methods of resonance radiation absorption and microwave diagnostics to the afterglow plasma following a weak pulsed discharge in the mixture neon, 1mm Hg $\times$ $H_2 \approx 1\%$. The cross section for $^3P_2$ deactivation increased from 0.7×10^{-15} cm^2 at 300° K to 2.5×10^{-15} cm^2 at 650° K. The cross section for ionization of H_2 by Ne metastable $^3P_2$ collision was 0.5×10^{-18} cm^2, and was compared against similar observations for the neon-metastable + argon collision. The reaction that converts neon metastable energy into Hα(6,563A) light was analyzed spectroscopically and formed a large fraction of the total deactivating collisions of neon metastable by H_2. These results are applied in a discussion of the effects that internal energy balance may have upon such polyatomic collisions. Observations upon d.c.-discharge plasmas were made and evidence collected to support and extend the above conclusions. Author

N64-25752 Ozark-Mahoning Co., Tulsa, Okla.
SYNTHESIS OF NEW FLUORINE CONTAINING COMPOUNDS Quarterly Technical Summary, 1 Apr.–30 Jun. 1964
J. B. Beal, Jr. and C. Pupp 8 Jul. 1964 9 p
(Contract AF 04(611)-9556; ARPA Order 24)
(AD-602290)

Experimental work consisted of the following: (1) continuation of work on solid–gas reactions; (2) infrared analysis of products of previous experiments using a Perkin–Elmer

IR-337 spectrophotometer; and (3) salt fusions and electrolysis of molten salts. The fusions were carried out in a nickel crucible or glass tube. Electrolyses were carried out in a stainless-steel cell into which a nickel crucible containing the salts could be placed. Author

N64-25781 General Telephone and Electronics Labs., Inc., Bayside, N.Y. Bayside Labs.
STUDY OF THIN FILM COMPOUNDS FORMED FROM SIMULTANEOUSLY EVAPORATED CONSTITUENTS Third Quarterly Report, Dec. 1, 1963–Feb. 29, 1964
A. K. Hagenlocher and A. E. Feuersanger 31 Mar. 1964 25 p refs
(Contract DA-36-039-AMC-00105(E))
(TR-64-206.3)

The preparation of lead titanate thin films by the simultaneous evaporation of lead and titanium oxides was continued with emphasis on controlling the evaporation rate of lead oxide during film deposition. Test thin-film capacitors with lead titanate dielectric were prepared with a specific capacitance of 1.7 $\mu F/cm^2$ and a dissipation factor of 7%. The preparation of lead titanate capacitors on silicon substrates was initiated. Author

N64-25784 Princeton U., N. J. Frick Chemical Lab.
VISCOELASTIC PROPERTIES OF MONODISPERSE POLYSTYRENE
A. V. Tobolsky, J. J. Aklonis, and G. Akovali Jun. 1964 27 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-81)

The viscoelastic properties of five monodisperse polymer samples of polystyrene ranging in molecular weight between 80,000 and 270,000 were studied and accurate values of η_1, J_e, τ_m, and E_m were obtained. The dependence on molecular weight of these quantities is very different from that predicted by the Rouse–Bueche theory or by the Ferry–Landel–Williams modification of this theory. Author

N64-25797 Brown U., Providence, R.I.
THE VISCOSITY OF THE ISOTOPES OF HYDROGEN AND THEIR INTERMOLECULAR FORCE POTENTIALS
J. Kestin and A. Nagashima Va. U., Charlottesville School of Eng. and Applied Sci. Dec. 1963 26 p refs Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(BRN-11-P; AD-429501)

The paper presents carefully measured values of the viscosity of the three isotopes of hydrogen: H_2, HD, and D_2 at 20° C and at 30° C, all under atmospheric pressure. The ratios of the viscosity of any one pair of the above gases is obtained very accurately, the major source of error being connected with the uncertainties in knowledge of the impurities present in the gases. On the basis of the Chapman–Enskog theory for the viscosity of gases composed of spherically symmetrical molecules whose potentials can be represented by the product $V(r) = \epsilon f(\sigma/r)$, it is concluded that all three isotopes have different intermolecular constants. However, the differences that characterize the intermolecular potentials of H_2 and D_2 are not likely to be large. Calculations that attempt to take into account the differences in the potentials of H_2 and D_2 by differences in polarizability are not confirmed by the present measurements. Author

N64-25829 Texas Instruments, Inc., Dallas
NEW HIGH TEMPERATURE INFRARED TRANSMITTING GLASSES Third Semiannual Technical Summary Report, 1 Nov. 1963–30 Apr. 1964
Maurice J. Brau and A. Ray Hilton [1964] 36 p refs
(Contract Nonr-3810(00))
(TI-08-64-78; AD-440439)

Glasses formed in the Ge-P-Te system have moderately high softening points (as high as 390° C) and are essentially transparent to the infrared out to 20μ wavelength. Their refractive indexes are greater than 3, and their glass-forming composition region is the smallest of all the systems evaluated. No ternary glass system was found using the group IVA element Sn that should be evaluated. With the Si-As-Te and Ge-As-Te glass systems as bases, the effect on the optical properties, softening point, and hardness was determined when P, Sb, S, and Se were substituted into the glasses. Author

N64-25831 Carnegie Inst. of Tech., Pittsburgh, Pa.
ANTIFERROMAGNETISM OF FERROUS CHLORIDE TETRAHYDRATE $FeCl_2 \cdot 4H_2O$
Norikiyo Uryu 13 Apr. 1964 37 p refs Submitted for Publication
(Contract Nonr-760(05))
(TR-21; AD-439393)

The antiferromagnetism of the monoclinic crystal $FeCl_2 \cdot 4H_2O$, especially its ordered spin arrangement, is considered. By replacing the spin operators in the appropriate spin Hamiltonian by the classical spin vectors, the lowest energy state of the spin arrangement is sought. The model similar to one proposed by Spence et al will be obtained as the lowest energy arrangement of the spins, although it differs in detail. In doing so, the four sublattice model and isotropic exchange interactions between magnetic ions up to the fourth nearest neighbors are assumed. The susceptibilities in the directions of the magnetic principal axes are calculated at 0° K in a classical way. Comparison with the experimental results permits estimating the exchange integrals in reasonable order of magnitude. Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-24337 Wisconsin U., Madison Mathematics Research Center
ON THE ASYMPTOTIC DISTRIBUTION OF THE LARGEST SAMPLE SPACING
Lionel Weiss Apr. 1964 19 p refs
(Contract DA-11-022-ORD-2059)
(MRC-471; AD-600739)

The limiting distribution of the largest sample spacing generated by independent, identically distributed random variables is obtained, under mild conditions on the common distribution. Applications are suggested. Author

N64-24344 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
PROGRAM SYSTEM FOR THE UTILIZATION OF THE REAL TIME METEOROLOGICAL SYSTEM FOR UNGUIDED ROCKET IMPACT PREDICTION

Vertis C. Cochran, Mary K. Barnes, and Louis D. Duncan Jun. 1964 118 p refs
(ERDA-148; AD-601651)

A complete flow chart, listing of the program, list of symbols used, and a list of a data deck are presented. Author

N64-24380 Boeing Scientific Research Labs., Seattle, Wash.
MATHEMATICS RESEARCH PROGRESS REVIEW, LAST SIX MONTHS 1963
B. H. Colvin et al Feb. 1964 27 p refs

The research activity reported encompasses work in a number of fields of mathematics, with applications to the flow of fluids, electromagnetic-wave propagation, celestial mechanics, control theory, reliability and systems analysis, Monte Carlo simulation, numerical analysis, and linear programing. Several studies of the influence of acceleration on rocket combustion processes are described. Progress is reported in a continuing study of methods to solve nonlinear systems of parabolic differential equations arising in aerodynamic boundary-layer theory. R.T.K.

N64-24381 Boeing Scientific Research Labs., Seattle, Wash.
A METHOD FOR PRODUCING RANDOM VARIABLES IN A COMPUTER Mathematical Note No. 342
George Marsaglia Feb. 1964 13 p refs
(D1-82-0341)

This paper describes a general procedure for producing random variables in a computer. The idea is to represent the required X in the form $X = c(M + U_1 = U_2 + U_3)$ some 97% to 99% of the time, where c is constant, M is a discrete random variable taking perhaps 8 values, and the U's are uniform random variables; the other 1% to 3% of the time, X is generated from a residual density by the rejection technique. These two methods for producing X are combined in the proper proportions in order that the resulting distribution for X be correct. The method is general in that it applies to a wide variety of density functions. Programs based on this procedure are very fast and require little computer storage—typically, 18 constants and 20 instructions. Author

N64-24394 Teledyne Systems Corp., Hawthorne, Calif.
AUTOMATIC PROGRAMMING TECHNIQUES (PHASE I) Final Report
P. Gilbert, J. Hosler, and C. Earnest Griffiss AFB, N.Y., RADC. Feb. 1964 191 p
(Contract AF 30(602)-2924)
(RADC-TDR-63-563; AD-434760)

This report describes the work done and results obtained in the second step of an overall effort to produce a programing system that will make possible the production of machine language programs for a wide class of machines from programs written in any problem-oriented language (i.e., JOVIAL, ALGOL, etc.). This particular effort involved writing and checking out the computer programs for the first half of this system and producing the specifications of the JOVIAL language. Author

N64-24535* National Aeronautics and Space Administration, Washington, D.C.
THE IMPORTANCE OF MATHEMATICS IN THE SPACE AGE
Raymond H. Wilson, Jr. Repr. from the Mathematics Teacher, v. 57, no. 5, May 1964 8 p Presented at the 23rd Summer Meeting of the Natl. Council of Teachers of Math., Eugene, Ore., 24 Aug. 1963
(NASA-RP-212)

A mathematical approach to space-age problems becomes necessary when direct measurement of all special cases is impossible or hopelessly expensive. The determination of the effects of the earth's magnetic field on space-vehicle spin, and the prediction of satellite spin rates are given as examples of the application of mathematics to space problems. D.S.G.

N64-24679 Chicago U., Ill.
GRAVITY MODES IN A ROTATING PARABOLOIDAL DISH
T. S. Murty (M. S. Thesis, Dec. 1962) *In its* Res. on Hydrodynamic Analogues of Large-Scale Meteorol. Phenomena Apr. 1964 p 1A1-1A65 refs (See N64-24678 17-21)

The effect of ellipticity of the free surface on the frequencies of axisymmetric normal gravity modes in a rotating shallow layer of liquid contained in a circular cylinder with paraboloidal bottom is investigated. Suitable nondimensional parameters are defined, namely a depth parameter, a rotation parameter, and a frequency parameter. The problem is formulated in terms of cylindrical polar coordinates. It is a Sturm-Liouville problem, and the differential operator is self-adjoint. The problem is solved by the Galerkin method, but the solution thus obtained is not in a closed form. The problem is also solved in a closed form by making use of the Legendre functions. A discussion of these Legendre function solutions is given, and the results are compared with those of the Galerkin method wherever possible. Lamb treated the gravity modes in a parabola without a cylinder without taking the ellipticity into account. In this paper the effect of ellipticity is included, and the results differ radically from those in which ellipticity is neglected. In particular, rotation has no effect on the frequency of the fundamental mode. Author

N64-24680 Chicago U., Ill. Hydrodynamics Lab.
EXPERIMENTS ON THE FREQUENCY OF FINITE-AMPLITUDE AXISYMMETRIC GRAVITY WAVES IN A CIRCULAR CYLINDER
D. Fultz and T. S. Murty *In its* Res. on Hydrodynamic Analogues of Large-Scale Meteorol. Phenomena Apr. 1964 p 1B1–1B10 refs Reprinted from J. of Geophys. Res., v. 68, no. 5, 1963 p 1457–1462 (See N64-24678 17-21)

Experiments are reported that confirm Mack's prediction that the fundamental symmetric standing wave on a layer of liquid in a circular cylinder will increase in frequency as the amplitude increases for a shallow layer but decrease in frequency for deep layers. The depth–diameter ratio at which the frequency effect reversal occurs is found to be about 0.054. The predicted ratio is 0.111. Author

N64-24688 Joint Publications Research Service, Washington, D.C.
FORMULATION OF THE PROBLEM OF RECOGNITION OF OBJECTS WITH MANY PARAMETERS AND METHODS OF SOLVING IT
V. L. Brailovskiy and A. L. Lunts *In its* Tech. Cybernetics 1 May 1964 p 26–43 refs (See N64-24685 17-16) OTS: $5.00

The problem of recognition is discussed as a problem of finding a classification rule that insures the maximum average gain. The problem is solved under the assumption that some a priori probability distributions are known, and that a sample is given for "training." Author

N64-24689 Joint Publications Research Service, Washington, D.C.
MINIMIZATION OF COMBINATION LOGICAL DIAGRAMS CONSTRUCTED FROM SINGLE-FUNCTIONAL ELEMENTS
V. M. Ozernoy *In its* Tech. Cybernetics 1 May 1964 p 44–49 refs (See N64-24685 17-16) OTS: $5.00

Procedures are described for minimization of combination logical diagrams constructed from single-function (unified) logical elements, which realize the negation of disjunctions

of many variables. An example of minimization of a function of four variables is considered. Author

N64-24691 Joint Publications Research Service, Washington, D.C.
SOME PROBLEMS IN THE REALIZATION OF BOOLEAN FUNCTIONS IN THRESHOLD ELEMENTS. I
Ye. A. Butakov and A. D. Zakrevskiy *In its* Tech. Cybernetics 1 May 1964 p 55–73 refs (See N64-24685 17-16) OTS: $5.00

A method is investigated for finding the realization of Boolean functions in a threshold element, based on the possibility of linearly regulating the systems of variables. The proposed algorithm permits, in 20 to 30 minutes, the realization of a Boolean function of six to eight variables or establishing that the given function is not threshold. The method permits generalization in the case of Boolean functions not entirely defined and may be programed for an electronic computer. Author

N64-24692 Joint Publications Research Service, Washington, D.C.
LOGICAL POSSIBILITIES OF ACTUAL THRESHOLD ELEMENTS
M. A. Rozenblat and M. B. Gendler *In its* Tech. Cybernetics 1 May 1964 p 74–96 refs (See N64-24685 17-16) OTS: $5.00

The logical possibilities of actual threshold elements are organized by the instability of the threshold, the presence of a zone of indeterminancy, within the limits of which the output signal of the threshold element is defined nonsinglevaluedly, and the instability of the input signals. In this article the influence of the indicated factors on the logical possibilities of the threshold elements is investigated in general form, and the conditions of fulfillment in them of the given threshold functions are determined. The results may be used in the design of logical systems in actual threshold elements of different types. Examples are given for using the results that are obtained. Author

N64-24693 Joint Publications Research Service, Washington, D.C.
AUTOMATIC CONTROL OF THE FUNCTIONING OF AN ELECTRONIC DIGITAL COMPUTER
A. V. Petrosyan and B. S. Mnatsakanyan *In its* Tech. Cybernetics 1 May 1964 p 97–108 refs (See N64-24685 17-16) OTS: $5.00

A method of control is proposed for the operation of automatons. This method makes it possible to control the operation of automatons with almost the same effectiveness as by duplication; a significantly smaller amount of supplementary equipment is required. On the basis of the method proposed, control circuits are worked out for various networks of electronic digital computers. The properties of the automatons that control the arithmetic circuit of an electronic digital computer for fulfillment of various operations by the latter are investigated. Author

N64-24694 Joint Publications Research Service, Washington, D.C.
ON THE CONSTRUCTION OF A LONG CODE FROM A SHORT ONE ENSURING THE CORRECTION CAPABILITY
Yu. L. Sagalovich and A. Yu. Sheverdyayev *In its* Tech. Cybernetics 1 May 1964 p 109–111 ref (See N64-24685 17-16) OTS: $5.00

A code of length n that corrects a set of error configurations exists. The problem is to construct a code of significantly great length n that checks the same set of error configurations. To accomplish this, it is desirable to insignificantly increase the number of checking symbols while greatly increasing the length of the code. At the same time, the rate of transmission must be increased, and the code retaining power and its correction capacity must be maintained. R.T.K.

N64-24695 Joint Publications Research Service, Washington, D.C.
APPLICATION OF CODE RINGS OF TYPE D IN CODE TRANSLATORS
G. F. Yanbykh *In its* Tech. Cybernetics 1 May 1964 p 112–129 refs (See N64-24685 17-16) OTS: $5.00

Procedures are discussed for coding of continuous variables with the use of code rings of type *D*—binary periodic sequences of symbols with a period equal to the product of the mutually prime numbers *p* and *q*. A translator is described (drumcode), as well as a code tracking system with fine and rough readings in which the code rings of type *D* are used. Author

N64-24697 Joint Publications Research Service, Washington, D.C.
ON RATIONAL PLANNING OF SEARCH OPERATIONS
Yu. V. Lyubatov *In its* Tech. Cybernetics 1 May 1964 p 141–151 refs (See N64-24685 17-16) OTS: $5.00

The problem of detection of a unique object located in one of *N* places and with a limited amount of available search effort is investigated. Strategy of distribution of the search effort is determined for optimum effort in the sense that at each point in time the average usefulness of the expanded search effort is maximum. If the amount of available search effort is unlimited, and the usefulness of detecting the objects does not depend on its location, then the strategy set up insures detection of the object with minimum average expenditure. Author

N64-24698 Joint Publications Research Service, Washington, D.C.
EXTREMAL CONTROL OF CONTINUOUS MULTI-PARAMETER SYSTEMS BY THE METHOD OF RANDOM SEARCH
V. A. Mutseniyeks and L. A. Rastrigin *In its* Tech. Cybernetics 1 May 1961 p 152–165 refs (See N64-24655 17-16) OTS: $5.00

The behavior of intertialess multiparameter systems of a general type is investigated on optimization by the method of random search. Application of this method to adjustment of continuous multiparameter systems is reduced to random selection of changes in control parameters. These changes are produced by random generators and are supplied to the integrators. G.D.B.

N64-24699 Joint Publications Research Service, Washington, D.C.
THE VARIATION APPROACH TO EVALUATIONS OF THE METHOD OF HARMONIC BALANCE
Ye. N. Rozenbasser *In its* Tech. Cybernetics 1 May 1964 p 166–184 refs (See N64-24685 17-16) OTS: $5.00

A method is discussed for investigation of periodic conditions in nonlinear automatic systems—a generalized method of harmonic balance permitting strict evaluations of the results. The concept is introduced of the generalized coefficient of harmonic linearization, and several ways of using it are indicated. Author

N64-24701 Joint Publications Research Service, Washington, D.C.
ON PROBLEMS OF OPTIMAL CONTROL
R. Gabasov and F. M. Kirillova *In its* Tech. Cybernetics 1 May 1964 p 199–214 refs (See N64-24685 17-16) OTS: $5.00

Optimal processes are investigated in related systems, which, in addition to limitations on the control parameters, have limitations on phase coordinates of one of the systems at fixed points in time. The optimal processes in the system are investigated, which, along with the usual controls, contain free parameters on the right-hand sides; it is possible to select them at given points in time. One problem is solved that is optimal with respect to rapid action for a system with a variable (control) order. Author

N64-24702 Joint Publications Research Service, Washington, D.C.
THE SYNTHESIS OF AUTOMATIC CONTROL SYSTEMS BY THE CRITERION OF MINIMUM LEAST MEAN SQUARE ERROR WITH A NON-ARBITRARY STRUCTURE
L. T. Chkhartishvili *In its* Tech. Cybernetics 1 May 1964 p 215–231 refs (See N64-24685 17-16) OTS: $5.00

Methods are reviewed for finding the transfer function of an automatic control system, insuring the minimum least square error in the case where a given part of the system is nonminimum in phase or unstable. A method is proposed, based on the theory of polynomial equations, that permits the determination of the optimum transfer function of the system for any form of a given part of the system. A comparative evaluation of the methods is given. Examples are presented that illustrate the proposed method. Author

N64-24709 Joint Publications Research Service, Washington, D.C.
CALCULATION OF THE INTERMEDIATE PROCESS IN THE PROBLEM OF STATISTICAL SYNTHESIS OF A PULSE SYSTEM
I. A. Petrov *In its* Tech. Cybernetics 1 May 1964 p 305–316 refs (See N64-24685 17-16) OTS: $5.00

Problems related to methods of mathematical statistics and to the theory of automatic control, and problems of total error in reproduction in the calculation of statistical errors in the intermediate process in the statistical synthesis of pulse systems with finite memories are considered. R.T.K.

N64-24854 Radio Corp. of America, New York, N.Y.
SYSTEMS CONSIDERATIONS FOR ICBM COMMAND AND CONTROL
C. G. Arnold *In* RCA, Camden, N.J. Systems Eng. and Space Technol. [1964] p 10–13 refs (See N64-24851 17-20)

Weapons system characteristics pertinent to command and control systems are discussed in terms of deployment, retaliation, unmanned missile sites, and weapon systems costs. G.D.B.

N64-24866 Maryland U., College Park
VALIDITY OF MANY BODY APPROXIMATION METHODS FOR A SOLVABLE MODEL III: DIAGRAM SUMMATIONS
A. J. Glick, H. J. Lipkin (Weizmann Inst. of Science, Israel), and N. Meshkov Oct. 1963 31 p refs
(Partially Supported by AFOSR)
(TR-334; AD-601260)

The model N-fermion system studied previously is reconsidered in order to investigate the range of validity of diagrammatic many-body perturbation theory and various selective summations of higher order graphs. The familiar random phase approximation or bubble graph sum is shown to be the first term in an expansion in powers of $1/N$ for which the coefficients are arbitrary functions of NV/ϵ where V is the interaction strength and ϵ is the level separation of the noninteracting system. However, the $1/N$ expansion converges very slowly (if at all) for $N < 40$. Other corrections to the bubble sum that do not fit into such an expansion are shown to be much more important than the $1/N$ corrections for small N. These are the exchange and self-energy graphs that correct for counting errors and violations of the exclusion principle when enumerating the states that a given particle can occupy. Author

N64-24875 Stanford Research Inst., Menlo Park, Calif.
GRAPHICAL DATA PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Progress Report 3, 1 Jan. - 31 Mar. 1964
A. E. Brain, D. J. Hall, and J. H. Munson Apr. 1964 33 p
(Contract DA-36-039-AMC-03247(E))
(R-15; AD-601742)

Several aspects of the practical procedures for using MINOS II are examined. The SDS 910 computer has been selected for use with MINOS II on the basis of an overall evaluation of characteristics. Some guidance is given on methods of input and output coding. The parity functions have been found useful for testing and checkout. Author

N64-24879 Aberdeen Proving Ground, Md. Ballistic Research Lab.
GRATIS—A MONTE CARLO COMPUTER PROGRAM FOR CALCULATING TRANSMISSION INFORMATION FOR SECONDARY GAMMA RADIATION
Alfred J. Budka Oct. 1963 62 p refs
(Rept.-1223; AD-436590)

A computer program, designed to calculate gamma ray transmission information for primary and secondary gamma radiation, is described. The Monte Carlo method is used. The program considers a plane stratified slab of finite thickness and infinite lateral dimensions, consisting of eight slab layers. Each layer may be made of any material. Gamma ray transmission information may be calculated for the following: (1) neutron-induced gamma rays distributed within a slab; (2) plane neutron-induced gamma rays distributed within a slab; (3) plane isotropic gamma-ray source located outside of a slab; slab plus neutron-induced gamma rays distributed in the slab; (4) monodirectional beams of gamma rays; and (5) bremsstrahlung originating within the slab. Author

N64-24880 Princeton U., N.J. Frick Chemical Lab.
NAVIER-STOKES CALCULATIONS OF ARGON SHOCK WAVE STRUCTURE
L. M. Schwartz and D. F. Hornig 1 Mar. 1963 29 p refs
(Contract Nonr-1858(24))
(TR-5; AD-298064)

The classical Navier–Stokes theory was used to calculate profiles of plane shock waves in argon. The viscosity-temperature relationship employed in the calculation was based on a Lennard-Jones 6-12 intermolecular potential function for which the parameters were derived from experimental viscosity measurements up to 1,100° K. With this viscosity function, the maximum-slope shock thicknesses obtained were smaller than previously calculated assuming viscosity proportional to $T^{0.816}$. Also, the maximum-slope thickness based on the density profile was less than that based on the velocity profile. The density profile thicknesses calculated with the Lennard–Jones viscosity function were the same order of magnitude as, but not in quantitative agreement with, experimental density thickness obtained with the optical reflectivity technique. Navier–Stokes profiles become

asymetric as the shock strength is increased. Even if this asymmetry were genuine, it would have a negligible effect on thickness measurements by the optical reflectivity method. Author

N64-24892* General Electric Co., Santa Barbara, Calif.
PLANNING A LEAST COST RELIABILITY CONSTRAINED DEVELOPMENT PROGRAM: A CAPACITATED NETWORK APPROACH
Paul M. Carrick, Jr. N.Y., AIAA [1964] 10 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.-2 Jul. 1964
(Contract NASw-686)
(AIAA Paper-64-410) AIAA: $0.50 members, $1.00 nonmembers

This paper presents the results obtained to date in developing a method for estimating the resource requirements for any future, technically complex, development program. Specifically, the approach is designed to provide a minimum cost test plan that will assure conformance to the reliability requirements and that, in addition, will satisfy the reliability constraint during the conduct of the more usual engineering experimental investigations. The proposed planning approach overlaps two categories of current research: First, it represents a slight extension of PERT-Cost logic in that it deals with selecting the least-cost development path from a rather large set of alternative paths, which are themselves defined by the existence of substitutability between resource inputs. Secondly, it represents a radical reorientation of the techniques for assuring conformance to the reliability requirements placed upon a program. Author

N64-24939 RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND TIME-DEPENDENT TRANSPORT PROCESSES
R. E. Bellman, H. H. Kagiwada, R. E. Kalaba, and M. C. Prestrud Feb. 1964 264 p refs
(ARPA-SD-79: ARPA Order-189-61)
(R-423-ARPA; ARPA-189-61; AD-441629)

The process for numerical inversion of Laplace transforms is described, as well as an idealized one-dimensional neutron transport process. Equations, which are derived for a time-dependent process using invariant imbedding, illustrate the use of the Laplace transform to reduce the analytical complexity of the equations; the numerical inversion procedure produces useful tables and graphs. Then, the time-dependent radiative process in a slab is treated. The physical background, analytic formulation, and computation procedures are discussed, and the FORTRAN programs are presented. Author

N64-24980* Alabama U., Research Inst., Huntsville Martin Co., Baltimore, Md.
ON A PROBLEM OF LETOV IN OPTIMAL CONTROL
C. D. Johnson and W. M. Wonham (Martin Co.) [1964] 10 p refs Submitted for Publication
(Contract NASw-845; Grant NsG-381)

In a series of papers, A. M. Letov discussed an optimal regulator problem for a linear plant with bounded control variable and quadratic index of performance. This problem was also discussed by Chang. Krasovskii and Letov observed later that the solution proposed may be correct only for special choices of the initial value of the state vector. Further aspects of the solution in the general case are described, and three examples are given. The possible existence of a condition of unsaturated-nonlinear optimal control is demonstrated. Author

N64-25069* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DECIMAL TO OCTAL CONVERSION TABLE FOR DECIMAL VALUES 0 TO 65,999
Phillip D. Merwarth Apr. 1964 222 p
(NASA-TM-X-55030; X-542-64-118) OTS: $15.00 ph

A decimal to octal conversion table is presented for decimal values 0 to 65,999. I.v.L.

N64-25077 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE DETERMINATION OF LAWS OF DISTRIBUTION ON THE BASIS OF A SMALL NUMBER OF OBSERVATIONS
V. V. Chavchanidze and V. A. Rumsishvili 8 Mar. 1963 18 p refs Transl. into ENGLISH from the Book "Primeneniye Vychislitel'noy Teckhniki Dlya Avtomatizatsii Proizvodstva" Moscow, Mashgiz, 1961 p 129–139
(FTD-TT-62-1048/1+2+4; AD-299643)

Although a complete answer is not given, the particular case of the prediction of laws of distribution on the basis of a small number of observations is considered; it is confined to the problems involved in the extraction of the maximum amount of information in the field of stochastic events. G.D.B.

N64-25089 Stanford U., Calif.
A COMPACTIFICATION THEORY WITH POTENTIAL-THEORETIC APPLICATIONS
John Edwin Wetzel 20 Dec. 1963 111 p refs
(Grant DA-ARO-(D)-31-124-G80)
(TR-26; AROD-1323-30; AD-431817)

A description is given of the construction of the endpoint compaction of an arbitrary semicompact Hausdorff space. The space is defined as the set of maximal ideals in the lattice of closed subsets that have compact boundaries. A description is presented of a compaction of a locally compact Hausdorff space, which is closely associated with a prescribed linear space of bounded, real-valued, continuous functions on the space. Harmonic functions on an open Riemann surface are also discussed. Author

N64-25094 Northwestern Technological Inst., Evanston, Ill. Systems Lab.
ON THE PROBABILISTIC NETWORKS
Y. Fu (Kansas U.) [1963] 15 p refs
(Grant AF-AFOSR-98-63)
(AROD-3298-10; AD-438497)

A probabilistic network is defined as a linear graph with its branch weights being statistically independent discrete random variables. A general probabilistic network function is formulated in terms of the reliabilities of individual branches. Some relationship between them is also discussed. Application to probabilistic switching network is considered. Author

N64-25169 Aeronautical Research Council (Gt. Brit.)
ON THE NUMERICAL CALCULATION OF THEODORSEN'S TRANSFORMATION
B. Thwaites London, HMSO, 1964 16 p refs
(CP-691; Supersedes ARC-24367) HMSO: 3s 6d

In applied mathematics, many problems that are describable by the two-dimensional Laplace equation reduce to the determination of a conformal transformation between some prescribed

region and one of standard shape. In such problems, it is a common practice to use simple subsidiary transformations in such a way that the final mapping to be determined is between a near-circle and a circle. The theory of Theodorsen is then, as often as not, applicable. This paper is presented as a standard computer program using Theodorsen's method. The particular program reproduced is for a Ferranti Pegasus. Possibly the only point of serious mathematical interest in the paper concerns the rearrangement of the integral equation to make it compatible with the numerical techniques employed. Author

N64-25274 Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
NON-PARAMETRIC MAXIMUM LIKELIHOOD ESTIMATION
Mathematical Note 326
G. B. Crawford and S. C. Saunders Oct. 1963 21 p refs
(D1-82-0308; AD-439259)

Given that a distribution function is a member of a subclass of absolutely continuous measures, the problem of nonparametric estimation is considered with the method of maximum likelihood, of the underlying density function of a given sample of independent identically distributed random variables. Sufficient conditions on the space of probability densities and its topology are given for the consistency of such an estimate. Author

N64-25275 Suffield Experimental Station, Ralston, Alberta (Canada)
NUMERICAL CALCULATION OF FOURIER INTEGRALS
O. F. Hastrup 4 Feb. 1964 9 p
(Suffield-TN-121; AD-438457)

The numerical calculation of Fourier integrals is of importance in the shock and blast field, and the present report gives the formulae for a method using linear interpolation. A few numerical examples are calculated using a program written for the Stantec Zebra digital computer to indicate the accuracy of the method. Author

N64-25280* National Aeronautics and Space Administration, Washington, D.C.
THE SOLUTION OF A SECOND ORDER DIFFERENTIAL EQUATION OF AN HYPERBOLIC TYPE BY REDUCING IT TO A SYSTEM OF INTEGRAL EQUATIONS [RESHENIYE DIFFERENTSIALBNOGO URAVNENIYA VTOROGO PORYADKA GIPERBOLICHESKOGO TIPA S POMOSCH'YU SVEDENIYA EGO K SISTEME INTEGRAL'NYKH URAVENIY]
T. V. Chekmarev Jun. 1964 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Mat. (Moscow), v. 36, no. 5, 1963 p 146–152
(NASA-TT-F-8738)

A differential equation of the second order $F(x,y,r,s,t) = 0$ (1) is assumed, where x and y are independent variables, $r = \partial^2 z/\partial x^2$, $s = \partial^2 z/\partial x \partial y$, $t = \partial^2 z/\partial y^2$, and z is some unknown function of arguments x and y. The object of this report is to find a solution to r, s, and t of equation (1) that could be reducible on line Σ: $x = x^{(0)}(\rho)$, $y = y^{(0)}(\rho)$ $(\rho_0 \leq \rho \leq \rho_1)$ to the system of functions $r^{(0)}(\rho)$, $s^{(0)}(\rho)$, $t^{(0)}(\rho)$. It is assumed in this connection that equation (1) on line Σ is of a hyperbolic type, that is on line $\Sigma F_s^2 - 4F_r F_t > 0$. I.v.L.

N64-25279* National Aeronautics and Space Administration, Washington, D.C.
ON THE EXISTENCE AND UNIQUENESS OF A PERIODIC SOLUTION TO A SINGLE NONLINEAR EQUATION OF A HYPERBOLIC TYPE [O SUSHCHESTVOVANII I EDINSTVENNOSTI PERIODICHESKOGO RESHENIYA ODNOGO NELINEYNOGO URAVNENIYA GIPERBOLICHESKOGO TIPA]
V. N. Karp Jun. 1964 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy (Moscow), v. 36, no. 5, 1963 p 43–50
(NASA-TT-F-8737)

Proof of the existence and uniqueness of a periodic solution to the nonlinear differential equation, $\partial^2 u/\partial t^2 - a^2 \partial^2 u/\partial x^2 = \phi(x, t) + \mu f(x, t, u, \partial u/\partial t)$, is offered, which satisfies the boundary conditions $\mu(0, t) = \mu(1, t) = 0$, and the periodicity conditions $u(x, 0) = u(x, 1)$, $\partial u(x, 0)/\partial t = \partial u(x, 1)/\partial t$, on the assumption that μ is the small parameter and constant factor of $a = p/q$ where $p = 2k + 1$ $(k = 0, 1, 2, \ldots)$ and $(p, q) = 1$. The unknown function $\mu(x, t)$ should be periodic according to the argument t with a period equal to one, and continuous together with its partial derivatives of the first two orders in a closed domain $D = \begin{pmatrix} 0 \leq x \leq 1 \\ 0 \leq t \leq 1 \end{pmatrix}$. I.v.L.

N64-25281* National Aeronautics and Space Administration, Washington, D.C.
ON THE METHOD OF SUCCESSIVE APPROXIMATIONS [O METODE POSLEDOVATEL'NYKH PRIBLIZHENIY]
Ye. P. Glebov and A. A. Potapenko Jun. 1964 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Mat. (Moscow), v. 36, no. 5, 1963 p 39–42
(NASA-TT-F-8739)

This report contains a proposed method for the solution of differential equation systems by successive approximations, similar to the Zeidel method for the solution of algebraic equations. I.v.L.

N64-25352 Northwestern Technological Inst., Evanston, Ill. Information-Processing and Control Systems Lab.
VERTEX REDUCTION NETWORK ANALYSIS
Howard Frank 1 Mar. 1964 44 p refs
(Grant AF-AFOSR-98-63)
(TR-9; AROD-3298-12; AD-438498)

The problem of topological network analysis is discussed, and various methods of tree generation summarized. It is concluded that no totally satisfactory method is available to generate the trees of a graph. The pliars entry and generalized star mesh transformations are then introduced, and a method to reduce any multiport passive network to a three terminal representation is described. The concepts thus developed are extended to include active networks whose currents have unique solutions. Finally, the applications of the reduction techniques to digital computer solutions are considered, and several related problems are introduced. Author

N64-25406 Illinois U., Urbana Coordinated Science Lab.
ON AN IMPROVED DIAGNOSIS PROGRAM
S. Seshu May 1964 15 p refs
(Contract DA-28-043-AMC-00073(E))
(R-207; AD-601156)

The present note describes an improved version written for the CDC-1604 computer. The principal improvements are in flexibility and intelligence. The present program was written

as a tool of research in the problem of self-diagnosis in electronic digital computers. Author

N64-25477 Illinois U., Urbana Electrical Engineering Research Lab.
RELATIVE CONVERGENCE OF THE SOLUTION OF A DOUBLY INFINITE SET OF EQUATIONS
R. Mittra Repr. from J. Res. Natl. Bur. Std., D. Radio Propagation, v. 67D, no. 2, Mar.–Apr. 1963 p 245–254 refs
(Contract AF 33(657)-10474)
(TR-69; AD-408828)

The paper deals with the relative convergence of a doubly infinite set of equations pertaining to a boundary value problem in a waveguide. The solution for the equations converges differently for different choices of the combinations of equations from the two sets. This is demonstrated by studying the convergence properties of the truncated set of equations as the number of equations is made indefinitely large. It is proven that the solution for the reflection coefficient becomes identical with the exact solution only with a particular choice of the ratio of the equations. This choice of the unique ratio is also shown to be consistent with the edge condition. Author

N64-25480 Joint Publications Research Service, Washington, D.C.
FERRITE CORES FOR MEMORY DEVICES
Yu. I. Vizun 15 Jul. 1964 29 p refs Transl. into ENGLISH from Elektron. Vychislitel'nyye Mashiny, (Moscow), 1963 p 1–49
(JPRS-25476; TT-64-31748)

This paper describes the basic characteristics of the memory cores made of VT-1, VT-7, and VT-6 ferrites developed by the Institute of Precision Mechanics and Computer Technology of the Academy of Sciences U.S.S.R. and recommended for use in operating storage devices. Author

N64-25487 Aberdeen Proving Ground, Md. Ballistic Research Labs.
NON-LINEAR ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS AND DIFFERENCE EQUATIONS
Gregory T. Mc Allister Aug. 1963 15 p refs
(BRL-MEMO-1215; AD-424182)

The Dirichlet problem for the nonlinear elliptic partial differential equation

$$a(x,y,u(x,y))u_{xx} + c(x,y,u(x,y))u_{yy} - \gamma(x,y,u(x,y))u = 0$$

is studied. It is assumed that the coefficients are strictly positive and according to Lipschitz in the argument u(x,y). It is then proved that the solution may be uniformly approximated by the solution to the associated difference equation, provided that a certain inequality, relating bounds on the coefficients, is satisfied. Author

N64-25508* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
ZERO-FIELD SPLITTING, ONE- AND TWO-CENTER COULOMB-TYPE INTEGRALS
Murray Geller and Richard W. Griffith Repr. from J. Chem. Phys., v. 40, no. 8, 15 Apr. 1964 p 2309–2325 refs
(Contract NAS7-100)
(NASA-CR-56782; JPL-TR-32-549)

One- and two-center Coulomb-type integrals of the form $\int [N,L,M]_{a1} O_{1,2} [N',L',M']_{b2} d\tau_1 d\tau_2$, where O_1 and O_2 are the two-particle operators $1/2r_{12}^{-5}(3z_{12}^2 - r_{12}^2)$ and $3r_{12}^{-5}(x_{12}^2 - y_{12}^2)$, respectively, needed in the evaluation of zero-field splitting, are evaluated in closed analytical form. Author

N64-25510 New York U., N.Y. Courant Inst. of Mathematical Sciences
ON A CLASS OF TESTING PROCEDURES IN LINEAR MODELS
Madan L. Puri Mar. 1964 14 p refs
(Contract Nonr-285(38))
(IMM-NYU-321; AD-437983)

Let $X_{ij}(j=1,...,m_i; i = 1,...,k)$ be independent samples from the populations with continuous cumulative distribution functions $F_i(x) = F(x-_i)$. For testing the hypothesis $H_0 : \xi_1 = ... = \xi_k$ against $H_1 : \xi_1 \leq ... \leq \xi_k$ (with at least one inequality strong) a class of test statistics based on the ranks of the observations are proposed, and their limiting distributions are derived. These results are used to obtain the asymptotic relative efficiencies (in the Pitman sense) with respect to one another and to the normal theory competitor. Author

N64-25525 Oak Ridge National Lab., Tenn. Mathematics Div.
AN APPROACH TO ALGOL TRANSLATION
A. A. Grau and L. L. Bumgarner Jun. 1964 90 p refs
(Contract W-7405-ENG-26)
(ORNL-3592)

The approach to Algol translation described is an extension and elaboration of that given in "The Structure of an Algol Translator." In machine-independent form are given specifications for a translator for Algol 60. These specifications have been obtained in the design and construction of the Oak Ridge Algol Compiler for the Control Data Corporation 1604. They may also be used with little modification to give an Algol translator for any present-day sequential machine. Author

N64-25528* National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
SOME STATISTICAL PARAMETERS RELATED TO THE NAKAGAMI-RICE PROBABILITY DISTRIBUTION
William R. Burns Repr. from Radio Sci. J. Res., v. 68D, no. 4, Apr. 1964 p 429–434 refs
(NASA Order R-68)

Formulas and tables are given for the mean and standard deviation of $R = 20 \log_{10} r$ where the random variable r has the Nakagami–Rice distribution. This distribution is of interest in connection with the short-term fading characteristics of some received radio fields. A particularly simple formula for the mean of R is obtained in terms of the well-known exponential integral function $-Ei(-x)$. Additional information concerning the median and interdecile range of R is also given. Author

N64-25580 RAND Corp., Santa Monica, Calif.
SOLUTION OF AN ABLATION PROBLEM
M. L. Juncosa Apr. 1964 8 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4067-PR; AD-602647)

The nonlinear integral equation

$$\phi(t) = \int_0^{\phi} d\xi / \sqrt{\phi(t) - \phi(\xi)},$$

giving the distance ϕ that the tip of a wedge or of a nose cone has ablated in time t, is solved in explicit terms. Author

N64-25622 RAND Corp., Santa Monica, Calif.
SOME THEOREMS ON FUNCTIONALS OF MARKOV CHAINS
Sidney C. Port Apr. 1964 41 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-3985-PR; AD-438439)

In this paper, various phenomena associated with a Markov process in discrete time were investigated, extending results found by previous authors. Recurrent events (i.e., to successive entrances into some fixed state of a Markov chain with the positive integers as states) are discussed; the working time distribution is completely determined by the sequence $\{EY_n\}$, where Y_n is the time, as observed from n, that the event last took place. Moreover, criteria for the event, when persistent, transient, positive, etc., may be given directly in terms of the EY_n. A particular class of null events called β-regular are examined where various joint-limit distributions for some of the functionals usually associated with these events are also examined. These limit laws are extended to situations more general than recurrent events, and these extended results are then applied to several concrete situations. Author

N64-25663 Maryland U., College Park Inst. for Fluid Dynamics and Applied Mathematics
ELLIPTIC DIFFERENCE OPERATORS AND DIRICHLET'S PROBLEM
Vidar Thomée Jan. 1964 36 p
(Grants DA-ARO-G134; NSF-GP-3)
(BN-345; AD-433695)

A general class of difference methods for the Dirichlet problem for elliptic equations with constant coefficients was studied. Under the assumption of the ellipticity and the consistency of the difference operator, it is shown that the solution of the discrete Dirichlet problem converges to the solution of the continuous counterpart when $h \to 0$(h is the mesh width). R.T.K.

N64-25667 Radio Corp. of America, Princeton, N.J. RCA Labs.
AUTOMATIC THEORY FORMATION: AN ANALYSIS OF AN APPROXIMATE SEQUENTIAL PROCEDURE FOR INTERVAL ESTIMATION
D. A. Walters Jul. 1963 107 p
(Contract AF 49(638)-1184)
(TN-1; AD-438559)

This report presents an approximate sequential method of interval estimation suitable for hypothesis testing in current research in artificial intelligence, in a study of its properties, and in a method of choosing parameter values to maximize its effectiveness. Relationships were found between the parameters of the procedure and its significant properties, including the probabilities of the two types of error and the expected number of samples required by the process. Several sets of parameters were chosen. Author

N64-25668* Wisconsin U., Madison Lab. of Molecular Structure and Spectra
TWO-CENTER EXPANSION FOR THE POWERS OF THE DISTANCE BETWEEN TWO POINTS
R. A. Sack (Royal Coll. of Advanced Technol.) Repr. from J. Math. Phys., v. 5, no. 2, Feb. 1964 8 p refs
(Grant NsG-275-62(4180); Contract Nonr-2121(01))

The powers r^n of the distance between two points specified by spherical polar coordinates relating to two different origins, or of the modulus of the sum of three vectors, are expanded in spherical harmonics of the angles. The radial factors satisfy simple partial differential equations, and can be expressed in terms of Appell functions F_4, and Wigner or Gaunt's coefficients. In the overlap region the expressions are valid for integer values of $n \geq -1$ but in the other regions, for arbitrary n. For high orders of the harmonics, individually large terms in the overlap region may have small resulting sums; as a consequence the two-center expansion is of limited usefulness for the evaluation of molecular integrals. Expansions are also derived for the three-dimensional delta function within the overlap region, and for arbitrary functions $f(r)$, valid outside that region. Author

N64-25691 David Taylor Model Basin, Washington, D.C. Applied Mathematics Lab.
THE CONVERGING FACTOR FOR THE EXPONENTIAL INTEGRAL
Francis D. Murnaghan and John W. Wrench, Jr. Jan. 1963 102 p refs
(DTMB-1535; AD-428924)

The term "converging factor" is generally defined as the factor by which the final term of a truncated series must be multiplied to yield the remainder of the series. In this report the converging factor associated with the asymptotic series for the exponential integral $Ei(x)$ of both positive and negative real argument x is discussed in detail, and numerical values for integral arguments are tabulated to 45 or more decimal places. Asymptotic series for the converging factor are rigorously developed, and the exact (rational) values of the first 21 coefficients therein are presented. A method for the evaluation of the exponential integral is presented in detail, and original tables of values of the exponential integral are given to 44 significant figures for integral values of x extending from 5 through 20 and to 50 decimal places for integral values of x ranging from -5 to -20, inclusive. Author

N64-25756 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MATHEMATICAL PROBLEMS IN CREATING A DIGITAL GRID ANALYZER
M. A. Aleksidze 27 Mar. 1963 30 p refs Transl. into ENGLISH from the book "Trudy Vyschislitel'nogo Tsentra" USSR, Akad. Nauk Gruzinskoy SSR, v. 1, 1960 p 263–282
(FTD-TT-62-1823/1+2; AD-401593)

The desirability, from the viewpoint of machine time, of using various iteration processes in specialized digital computers for digital grid analysis is discussed. Mathematical problems dealing with the asymptotic relationships between the local and integral errors for the different iteration processes are described. J.L.D.

N64-25777 Maryland U., College Park
UNIQUENESS AND NONLINEARITY
Simon A. Levin (Ph.D. Thesis) May 1964 68 p refs
(Contract DA-ARO(D)-31-124-G-134)
(TN-BN-354; AROD-407-65)

The problem is to determine the boundary conditions under which the solution to the quasi-linear partial differential equation $L[O] = Ar + 2Bs + Ct = D$ is unique. Here the partial derivatives of $O_i = O_i(x,y)$ are denoted according to Monge. It is proven that a nonsupersonic flow is uniquely determined by its circulation and mass flux on the boundary. These results are extended, and uniqueness is obtained in certain cases of mixed flows and for more general boundary problems, e.g., an analog of Stekloff's problem. A number of uniqueness results for nonlinear problems for the equation $\Delta O = F(x,y,O,p,q)$ are obtained. Applications of the determination method to equations arising in differential geometry are given. A byproduct of the investigation was the study of overdetermined systems of partial differential equations. This study is described. I.v.L.

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-24401* National Aeronautics and Space Administration, Washington, D.C.
PROCEEDINGS OF THE ALL-UNION SCIENTIFIC METEOROLOGICAL CONFERENCE, VOLUME I [TRUDY VSESOYUZNOGO NAUCHNOGO METEOROLOGICHESKOGO SOVESHANIYA]
M. I. Budyko ed. May 1964 289 p refs Transl. into ENGLISH from the Russian, Leningrad, Hydrometeorological Publishing House, 1962
(NASA-TT-F-168) OTS: $4.00

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8. INVESTIGATION OF THE STRUCTURAL PARAMETERS OF THE ATMOSPHERE AT ALTITUDES OF MORE THAN 90–100 KM PERFORMED IN THE USSR BY MEANS OF ROCKETS AND ARTIFICIAL EARTH SATELLITES B. A. Mirtov p 153–170 refs (See N64-24409 17-21)
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11. STUDY OF THE GENERAL CIRCULATION OF THE ATMOSPHERE Kh. P. Pogosyan p 198–219 refs (See N64-24412 17-21)
12. RESULTS OF STUDIES OF THE CLIMATE OF THE USSR O. A. Drozdov and Ye. S. Rubinshteyn p 220–242 (See N64-24413 17-21)
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N64-24402* National Aeronautics and Space Administration, Washington, D.C.
OPENING ADDRESS OF THE DEPUTY DIRECTOR OF GUGMS
K. T. Loginov *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 38–42 (See N64-24401 17-21) OTS: $4.00

This is a nontechnical article reviewing the hydrometeorological service—its history and contributions—on the occasion of the 40th anniversary of its establishment in the U.S.S.R.
G.D.B.

N64-24403* National Aeronautics and Space Administration, Washington, D.C.
40 YEARS OF THE SOVIET HYDROMETEOROLOGICAL SERVICE
A. A. Zolotukhin *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 43–67 (See N64-24401 17-21) OTS: $4.00

The history of the Soviet hydrometeorological service is presented, giving the important dates and persons involved in its development since 1921.
G.D.B.

N64-24404* National Aeronautics and Space Administration, Washington, D.C.
STATUS AND PROSPECTS FOR THE SOLUTION OF THE PROBLEM OF THE CONTROL OF WEATHER AND CLIMATE
Ye. K. Fedorov *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 68–81 (See N64-24401 17-21) OTS: $4.00

A nontechnical exposition is presented in which the status, future prospects, importance, and some techniques of weather and climate control are discussed.
G.D.B.

N64-24405* National Aeronautics and Space Administration, Washington, D.C.
RESULTS OF METEOROLOGICAL INVESTIGATIONS IN THE ARCTIC AND ANTARCTIC
I. M. Dolgin, D. L. Laykhtman, N. P. Rusin, and A. F. Treshnikov *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 82–102 (See N64-24401 17-21) OTS: $4.00

Results of meteorological investigations in the Arctic and Antarctic are discussed in the following categories: air temperature at the surface, distribution of air temperature in the upper atmosphere, wind distribution at the surface and in the upper atmosphere, distribution of moisture content at the surface and its variation with height, radiation conditions, eddy heat and moisture transfer, and ice conditions in the arctic basin.
G.D.B.

N64-24406* National Aeronautics and Space Administration, Washington, D.C.
STATUS AND PROSPECTS OF THE SYNOPTIC METHOD OF WEATHER FORECASTING
V. A. Bugayev *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 103–116 (See N64-24401 17-21) OTS: $4.00

Discussed in this article are the following: (1) growth of the volume of information received; (2) mechanization and automation of synoptic work and the introduction of computers; (3) development of the hydrodynamic theory of motion of the atmosphere and quantitative methods of forecasting the pressure field; (4) aircraft penetration of the upper troposphere and stratosphere; and (5) rise in the requirements for short-term forecasts and a more precise statement of these requirements by interested organizations.
G.D.B.

N64-24407* National Aeronautics and Space Administration, Washington, D.C.
MODERN METHODS AND PROBLEMS OF NUMERICAL WEATHER FORECASTING
M. I. Yudin *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 117-130 refs (See N64-24401 17-21) OTS: $4.00

Modern methods and problems of numerical weather forecasting are discussed in terms of combating inaccurate representation of the initial geopotential field, inaccuracy of the physical model due to simplifications and the neglect of various factors in deriving the equations, and inaccuracies in the mathematical solution of the problem. G.D.B.

N64-24408* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF UPPER ATMOSPHERIC LAYERS BY MEANS OF METEOROLOGICAL ROCKETS
P. P. Alekseyev, Ye. A. Besyadovskiy, L. A. Biryukova, G. I. Golyshev, A. I. Ivanovskiy et al *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 131–152 refs (See N64-24401 17-21) OTS: $4.00

Measuring methods, seasonal variations of temperature, temperature stratification in the stratosphere, temperature inversion over the stratopause in polar-night conditions, temperature fields over the Northern Hemisphere, and some data on the circulation in the stratosphere and mesosphere are described in this article concerning the investigation of upper atmospheric layers by meteorological rockets. G.D.B.

N64-24409* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF THE STRUCTURAL PARAMETERS OF THE ATMOSPHERE AT ALTITUDES OF MORE THAN 90–100 KM PERFORMED IN THE USSR BY MEANS OF ROCKETS AND ARTIFICIAL EARTH SATELLITES
B. A. Mirtov *In its* Proc. of the All-Union Sci. Meteorol. Conf., vol. I May 1964 p 153–170 refs (See N64-24401 17-21) OTS: $4.00

Soviet advances in meteorological rocket and satellite research are reviewed by discussing prerocket investigations, Russian uniqueness in this field, composition of the upper atmosphere, structure of the ionosphere, hydrogen and helium, nitrogen, physics of high layers, investigation of solid interplanetary matter, and atmospheric density. G.D.B.

N64-24410* National Aeronautics and Space Administration, Washington, D.C.
THE HEAT BALANCE OF THE EARTH
M. I. Budyko *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 171–185 ref (See N64-24401 17-21) OTS: $4.00

Reviewed in this article are Soviet developments in the study of the heat balance of the earth as one of the principal scientific problems relating to the atmosphere. Some 80 years ago, A. I. Voyeykov saw the importance of this factor, but his theories were only recently tested. G.D.B.

N64-24411* National Aeronautics and Space Administration, Washington, D.C.
STUDIES OF ATMOSPHERIC TURBULENCE
A. M. Obukhov *In its* Proc. of the All-Union Sci. Meteorol. Conf. Vol. I May 1964 p 186–197 refs (See N64-24401 17-21) OTS: $4.00

Research on atmospheric turbulence is of great importance for the solution of problems in air navigation, weather forecasting, agricultural meteorology, and radio communications. Soviet investigation of motions in the atmosphere, by a combination of static and dynamic methods, is reviewed. G.D.B.

N64-24412* National Aeronautics and Space Administration, Washington, D.C.
STUDY OF THE GENERAL CIRCULATION OF THE ATMOSPHERE
Kh. P. Pogosyan *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I. May 1964 p 198–219 refs (See N64-24401 17-21) OTS: $4.00

The study of the general circulation of the atmosphere is one of the principal interests of meteorologists all over the world. It is widely recognized that physically well-founded methods of long-range weather forecasting are based on knowledge of the patterns of atmospheric behavior. This is a survey of work done in this field, especially by Russian scientists. G.D.B.

N64-24413* National Aeronautics and Space Administration, Washington, D.C.
RESULTS OF STUDIES OF THE CLIMATE OF THE USSR
O. A. Drozdov and Ye. S. Rubinshteyn *In its* Proc. of the All-Union Sci. Meteorol. Conf., vol. I May 1964 p 220–242 (See N64-24401 17-21) OTS: $4.00

The climatic conditions of the U.S.S.R. were studied from the following points of view: energetics of the atmosphere, investigations of atmospheric circulation, moisture resources, variation of climate, climatic regionalization, climatography, and the applications to health and agriculture. G.D.B.

N64-24414* National Aeronautics and Space Administration, Washington, D.C.
THE AGROCLIMATIC RESOURCES OF THE USSR AND ADVANCES IN THE AGROMETEOROLOGICAL SERVICE
F. F. Davitaya *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 243–256 (See N64-24401 17-21) OTS: $4.00

Research into climate and weather as an aid to agriculture was developed along three main lines: assessment of climate for agricultural purposes, consideration of climatic conditions in devising measures for dealing with adverse meteorological factors, and developing methods of agrometeorological information and forecasts. G.D.B.

N64-24415* National Aeronautics and Space Administration, Washington, D.C.
THE MECHANIZATION OF METEOROLOGICAL DATA PROCESSING
P. K. Yevseyev *In its* Proc. of the All-Union Sci. Meteorol. Conf., Vol. I May 1964 p 257–267 (See N64-24401 17-21) OTS: $4.00

The vast amount of meteorological data being received from thousands of weather stations all over the U.S.S.R.—35 million individual observations a year—has made rapid data processing essential for the success of the Soviet hydrometeorological service. A review of past and current processing techniques of meteorological data is presented. G.D.B.

N64-24451 McGill U., Montreal (Canada) Arctic Meteorology Research Group
SEMINARS ON THE STRATOSPHERE AND MESOSPHERE AND POLAR METEOROLOGY Scientific Report No. 9
F. K. Hare et al Jan. 1964 233 p refs Contrib. to Seminars held at Stanstead Coll., Quebec, 7–19 Jul. 1963 *Its* Publ. in Meteorol. No. 65
(Contract AF 19(604)-8431)
(AFCRL-64-197; AD-600664)

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32. RECENT OZONE OBSERVATIONS IN THE ANTARCTIC STRATOSPHERE S. Weyant (Weather Bur., Washington) p 219–220 refs (See N64-24483 17-21)

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35. HEAT BUDGET OF THE ARCTIC E. Vowinckel and S. Orvig p 241–243 refs (See N64-24486 17-21)

N64-24452 McGill U., Montreal (Canada)

SOME COMMENTS ON THE INTERACTION OF ATMOSPHERIC LAYERS

B. W. Boville *In its* Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 1–6 refs (See N64-24451 17-21)

The wave activity and final warmings of the winter stratospheric vortices in both atmospheres represent perturbations whose amplitudes increase with time in the presence of large horizontal temperature gradients, and thus are manifestations of baroclinic instability. This article considers some wave types, implications of the second law of thermodynamics, and suggestions for easier study of the interaction of atmospheric layers. G.D.B.

N64-24453 Weather Bureau, Washington, D.C.

THE ROLE OF THE STRATOSPHERE IN THE TROPOSPHERIC DEVELOPMENTS

G. P. Cressman *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 7–10 refs (See N64-24451 17-21)

To understand possible stratospheric influences in developing tropospheric systems, the nature of tropospheric development is closely examined. Systems are excluded whose behavior is essentially equivalent barotropic in nature; development is defined as an event, which in midtroposphere is not described by the conservation of absolute vorticity. G.D.B.

N64-24454* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOME SYNOPTIC FEATURES OF STRATOSPHERIC CIRCULATION

G. Warnecke *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 11–14 refs (See N64-24451 17-21)

The various forms and changes of stratospheric circulation throughout the year were demonstrated by a series of daily synoptic maps. Within the layers between 20 and 30 km exist great deviations from a mere radiation controlled temperature throughout the year, especially over northern areas of the Pacific Ocean. G.D.B.

N64-24455* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE YEARLY AND LONG-PERIOD CHANGES OF STRATOSPHERIC CIRCULATION
G. Warnecke *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 15–17 refs (See N64-24451 17-21)

The yearly and long-period changes of stratospheric circulation are discussed, particularly as to the contrast between the seasons. G.D.B.

N64-24456 Canada. Dept. of Transport, Toronto Meteorological Branch
TIME SERIES STUDY OF STRATOSPHERIC-TROPOSHERIC RELATIONS
F. B. Muller *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 19–22 (See N64-24451 17-21)

As a preliminary to the development of interaction between troposphere and middle stratosphere, a project is underway to study time series consisting of evaluations of varous terms that enter the differentiated equations of motion, or that are subjectively evaluated by the synoptic meteorologist. G.D.B.

N64-24457 Weather Bureau, Washington, D.C.
THE ANTARCTIC STRATOSPHERE
W. S. Weyant *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 23–25 refs (See N64-24451 17-21)

Dissimilarities between the Arctic and Antarctic regions are discussed. Some of the first results of IGY effort in Antarctica are reviewed. Time cross sections of temperatures from three Antarctic stations illustrated the persistence of the surface inversion layer, a small annual variation of tropospheric temperatures, and the large annual variation of stratospheric temperatures. G.D.B.

N64-24458 Weather Bureau, Washington, D.C.
THE MASS AND HEAT BUDGET OF THE ANTARCTIC ATMOSPHERE
M. B. Rubin and W. S. Weyant *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 27–28 (See N64-24451 17-21)

A chart is given to illustrate the mean mass transports and vertical motions in the Antarctic atmosphere during 1958. G.D.B.

N64-24459 Air Force Cambridge Research Labs., Bedford, Mass. Geophysics Research Directorate
STRATOSPHERIC ENERGY STUDIES
A. A. Barnes, Jr. *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 29–34 ref (See N64-24451 17-21)

Stratospheric energy studies are presented in terms of the rate of change of kinetic energy, the rate of change of potential plus internal energy, the rate of change of the zonal kinetic energy, and the importance of eddy transports in the stratosphere. G.D.B.

N64-24460 McGill U., Montreal (Canada)
INSTABILITY IN THE MIDDLE STRATOSPHERE
B. E. O'Reilly *In its* Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 35–45 (See N64-24451 17-21)

Discussed are some of the limitations of using models in stratospheric studies. Those devised by Murray, Stern, and Charney are examined; Fleagle's model is discussed at some length. G.D.B.

N64-24461 National Center for Atmospheric Research, Boulder, Colo.
ENERGY TRANSFORMATIONS IN THE ATMOSPHERE
A. Wiin-Nielsen *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 49–51 refs (See N64-24451 17-21)

Maximum transport of sensible heat occurs in middle latitudes and at lower elevations. Transport of momentum is northward south of about 55° N and southward, north of this latitude. Conversion of eddy kinetic energy to zonal kinetic energy is positive when summed over all wave numbers. G.D.B.

N64-24462 McGill U., Montreal (Canada)
KINEMATIC DIVERGENCE AND LARGE-SCALE ENERGY CONVERSION
A. Eddy *In its* Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 53–60 (See N64-24451 17-21)

Transformations from potential to kinetic energy within a particular storm are discussed. Kinetic energy production was most pronounced ahead of the moving surface cyclone. The pattern resupported the precept that a weather system need be thought of as the combination of the high-pressure and low-pressure areas, and not as just the low itself. G.D.B.

N64-24463 Weather Bureau, Washington, D.C.
AUTOMATIC PROCESSING OF METEOROLOGICAL DATA
G. P. Cressman *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 61–63 (See N64-24451 17-21)

This article considers the automatic processing of meteorological data required in the operation of a large-scale and forecasting center. Some new methods of data handling for data exchange among research workers are presented. G.D.B.

N64-24464 Weather Bureau, Washington, D.C.
OBJECTIVE ANALYSIS
G. P. Cressman *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 65–68 refs (See N64-24451 17-21)

Objective analysis of weather data is discussed. It is defined as that part of treatment of the data in which observations proceed from randomly located points to the required field values at the regularly located points of the grid. G.D.B.

N64-24465 Douglas Aircraft Co., Inc., Santa Monica, Calif.
COMPUTER APPLICATIONS IN STRATOSPHERIC ANALYSIS AND FORECASTING
F. W. Murray *In* McGill U. Seminars on the Stratosphere and Mesophere and Polar Meteorol. Jan. 1964 p 69–81 (See N64-24451 17-21)

Computer applications in stratosphere analysis and forecasting are described. Some 19 steps are required in the data processing of an ordinary ADP run by USAF; these are discussed. G.D.B.

N64-24466 McGill U., Montreal (Canada)
A BAROCLINIC MODEL FOR THE CANADIAN NUMERICAL WEATHER PREDICTION PROGRAM
A. Robert *In its* Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 83–88 (See N64-24451 17-21)

A group of Canadian meteorologists tested models of the atmosphere in preparation for an operational numerical weather prediction program. Their experiences and the resulting baroclinic model are described in this article. G.D.B.

N64-24467 Pennsylvania State U., University Park
ON OBJECTIVE ANALYSIS OF STRATOSPHERIC DATA BY SASAKI'S METHOD
W. M. Washington and R. T. Duquet *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 89–111 refs (See N64-24451 17-21)

Sasaki's method for objective analysis of stratospheric data is discussed in terms of derivation of the analysis equation, wavelength characteristics of the analysis equation, influence function of the analysis equation, and shear and curvature. G.D.B.

N64-24468 Canada. Dept. of Transport, Toronto Meteorological Branch
TWENTY-SIX-MONTH OSCILLATIONS IN GEOPHYSICAL PHENOMENA
W. L. Godson *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 115–129 (See N64-24451 17-21)

Twenty-six-month oscillations in geophysical phenomena are examined under the categories of ancient history, modern history, equatorial stratospheric oscillations, tropospheric oscillations in middle and high altitudes, and harmonic analyses of solar and related parameters. G.D.B.

N64-24469 Colorado U., Boulder
ATMOSPHERIC TIDES
B. Haurwitz *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 131–132 (See N64-24451 17-21)

Of the oscillations referred to as atmospheric tides, the most important are those with a 12-hour period, a 24-hour period, and with a period of 12 lunar hours. G.D.B.

N64-24470 Chicago U., Ill.
INTERNAL ATMOSPHERIC GRAVITY WAVES
C. O. Hines *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 133–134 ref (See N64-24451 17-21)

Internal atmospheric gravity waves, the low-frequency equivalents of ordinary acoustic waves with characteristics different from those of sound waves, are discussed. G.D.B.

N64-24471 Chicago U., Ill.
TURBULENCE IN THE UPPER ATMOSPHERE
C. O. Hines *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 135–136 (See N64-24451 17-21)

Long-enduring meteor trails appear to expand at rates too fast to be explained by molecular diffusion alone. This behavior is attributed to turbulent diffusion, examined briefly in this article. G.D.B.

N64-24472 Air Force Cambridge Research Labs., Bedford, Mass. Geophysics Research Directorate
RADAR METEOR TRAIL SETS
A. A. Barnes, Jr. *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 137–138 ref (See N64-24451 17-21)

Radar meteor trail sets capable of measuring wind and density in the upper atmosphere are described. G.D.B.

N64-24473 Canadian Armament Research and Development Establishment, Valcartier
AIRGLOW STUDIES AT *CARDE*
J. Hampson *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 139–148 refs (See N64-24451 17-21)

Measurements of night hydroxyl radiation suggest knowledge of the temporal behavior would assist interpretation of the mechanisms responsible. Airglow studies, both night and day, from Canadian observations are described. G.D.B.

N64-24474 McGill U., Montreal (Canada)
CHEMICAL AERONOMY
H. I. Schiff *In its* Seminars on the Stratosphere and Mesosphere and Radar Meteorol. Jan. 1964 p 149–152 (See N64-24451 17-21)

Meteorologists have become increasingly interested in the atmosphere between 20 and 120 km, since the chemical processes that occur in this region play important roles in determining both composition and heat balance. Some aeronomic processes in this area are discussed. G.D.B.

N64-24475 Colorado U., Boulder
ABSORPTION PROCESSES IN THE UPPER ATMOSPHERE
J. London *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 153–156 refs (See N64-24451 17-21)

The major diabatic energy source for the region of the atmosphere between 30 and 70 km is that due to the absorption of solar ultraviolet radiation by ozone. The net result of this absorption of solar energy is to produce a photochemical equilibrium of ozone; this process is described. G.D.B.

N64-24476 McGill U., Montreal (Canada)
OZONE AND THE CURTIS-GODSON APPROXIMATION
W. Hitschfield *In its* Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 157–165 refs (See N64-24451 17-21)

A transfer theory—the Curtis–Godson approximation—and a radiation chart are discussed to explain the occasionally important role played by ozone in the atmosphere. G.D.B.

N64-24477 Toronto U., (Canada)
THE OZONE OF THE STRATOSPHERE AND ITS TRANSPORT
A. W. Brewer *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 169–178 (See N64-24451 17-21)

The interest in atmospheric ozone lies primarily in the information it can give regarding transport processes in the stratosphere. The transport of ozone and its fluctuations are discussed. A series of charts showing the regions of ozone formation are included; they cover such diverse locations as Liverpool, the Azores, Kodai, and Malta. G.D.B.

N64-24478 National Center for Atmospheric Research, Boulder, Colo.
RADIOACTIVE TRACER RESULTS
E. A. Martell *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 179–193 refs (See N64-24451 17-21)

Radioactive tracer results are viewed from the points of polar stratosphere mixing and equatorial stratosphere mixing. Given are radioactive aerosol properties, Rh-102 high-altitude tracer, India profile, tungsten-185 results, and seasonal variations. G.D.B.

N64-24479 Colorado U., Boulder
THE DISTRIBUTION OF TOTAL OZONE
J. London *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 195–200 refs (See N64-24451 17-21)

Although ozone is formed in the atmosphere as a result of photochemical processes, its geographic distribution and time variation are strongly modified by atmospheric transport processes. The distribution of ozone by location and season is described. G.D.B.

N64-24480 Air Force Cambridge Research Labs., Bedford, Mass. Geophysics Research Directorate
AN ANALYSIS OF OZONESONDE MEASUREMENTS OVER NORTH AMERICA
W. S. Hering *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 201–206 refs (See N64-24451 17-21)

The ozonesonde network in North America provides data for this analysis of measurements. Some of the general features of the vertical ozone distribution as revealed by the initial results from the network program are presented graphically. G.D.B.

N64-24481 Japan. Ministry of Transportation, Tokyo
VARIATION OF TOTAL OZONE AND VERTICAL OZONE DISTRIBUTION
M. Shimizu *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 207–211 (See N64-24451 17-21)

To separate and compare the effects of Ferrel disturbances and middle stratospheric phenomena on total ozone amounts, calculations were made and are presented. G.D.B.

N64-24482 Air Force Cambridge Research Labs., Bedford, Mass. Geophysics Research Directorate
PRELIMINARY AIRCRAFT OBSERVATIONS OF OZONE IN THE STRATOSPHERE
S. Penn *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 213–217 (See N64-24451 17-21)

The first measurements of ozone taken along nearly horizontal trajectories in the middle stratosphere are presented. The Regener instrument was used. Several flights for the observation of ozone are described. G.D.B.

N64-24483 Weather Bureau, Washington, D.C.
RECENT OZONE OBSERVATIONS IN THE ANTARCTIC STRATOSPHERE
W. S. Weyant *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 219–220 refs (See N64-24451 17-21)

This article very briefly reviews some ozone observations and measurements made in Antarctica during the IGY program. G.D.B.

N64-24484 Quartermaster Research and Engineering Command, Natick, Mass.
ANTARCTIC MICROMETEOROLOGY AND CLIMATOLOGY
P. C. Dalrymple *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 223–229 (See N64-24451 17-21)

Monthly mean temperatures at the South Pole are given in tabular form as a basis for this review of Antarctic micrometeorology and climatology. G.D.B.

N64-24485 Wisconsin U., Madison
CORRESPONDENCE BETWEEN THEORETICAL MODELS AND ACTUAL OBSERVATIONS IN ARCTIC MICROMETEOROLOGY
H. H. Lettau *In* McGill U. Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 p 231–239 (See N64-24451 17-21)

The exceptional quantity and high quality of South Pole weather data permitted an unusually detailed and systematic analysis of the curvature characteristics of micrometeorological wind and potential temperature profiles. G.D.B.

N64-24486 McGill U., Montreal (Canada)
HEAT BUDGET OF THE ARCTIC
E. Vowinckel and Svenn Orvig *In its* Seminars on the Stratosphere and Mesosphere and Polar Meteorol. Jan. 1964 241-243 refs (See N64-24451 17-21)

A brief summary of Arctic heat budget studies is presented—energy exchange between the earth's surface and the atmosphere, solar radiation, terrestrial radiation, and heat balance. G.D.B.

N64-24558 Joint Publications Research Service, Washington, D.C.
ROCKETS STUDY NOCTILUCENT CLOUDS
V. A. Bronshten *In its* Noctilucent Clouds and the Cyclic Nature of the Earth's Develop. 5 Jun. 1964 p 1–9 (See N64-24557 17-12) OTS: $0.75

Noctilucent (luminous) clouds occupy a very narrow range of altitudes—from 75 to 90 km—and are observed in a narrow belt of latitudes—from 50° to 60°. They are observed only from the end of May to the middle of August. Three hypotheses were advanced to explain the nature of noctilucent clouds: (1) the volcanic hypothesis; (2) the meteor hypothesis; and (3) the ice hypothesis. These hypotheses are briefly discussed. Particles of noctilucent clouds collected from rocket flights indicate that they are of a meteor—ice nature. N.E.A.

N64-24678 Chicago U., Ill. Hydrodynamics Lab.
RESEARCH ON HYDRODYNAMIC ANALOGUES OF LARGE-SCALE METEOROLOGICAL PHENOMENA Final Report
Dave Fultz Apr. 1964 292 p refs
(Contract AF 19(604)-8361; Grants NSF G-10184; NSF GP-613)
(AFCRL-64-382; AD-601001)

CONTENTS:

1. GRAVITY MODES IN A ROTATING PARABOLOIDAL DISH T. S. Murty p 1A1–1A65 refs (See N64-24679 17-20)
2. EXPERIMENTS ON THE FREQUENCY OF FINITE-AMPLITUDE AXISYMMETRIC GRAVITY WAVES IN A CIRCULAR CYLINDER D. Fultz and T. S. Murty p 1B1–1B10 refs (See N64-24680 17-20)
3. A NOTE ON AN ANALOGUE OF THE MONTGOMERY STREAM FUNCTION D. Fultz p 1C1–1C7 refs (See N64-24681 17-13)
4. AN EXPERIMENTAL VIEW OF SOME ATMOSPHERIC AND OCEANIC BEHAVIORAL PROBLEMS D. Fultz p 2A1-2A14 refs (See N64-24682 17-21)
5. EXPERIMENTAL INVESTIGATIONS OF THE SPECTRUM OF THERMAL CONVECTIVE MOTIONS IN A ROTATING ANNULUS D. Fultz, J. Kaiser, M. Fain, R. E. Kaylor, and J. Weil p 2B1–2B89 refs (See N64-24683 17-13)

N64-24682 Chicago U., Ill. Hydrodynamics Lab.
AN EXPERIMENTAL VIEW OF SOME ATMOSPHERIC AND OCEANIC BEHAVIORAL PROBLEMS
Dave Fultz *In its* Res. on Hydrodynamic Analogues of Large-Scale Meteorol. Phenomena Apr. 1964 p 2A1–2A14 refs Reprinted from Trans. of the N.Y. Acad. of Sci., ser. 2, v. 24, no. 4, Feb. 1962 p 421–446 Presented at a Meeting of the Sect. of Planetary Sci., 23 Jan. 1962 (See N64-24678 17-21)

Selected topics demonstrating the role of suitably designed physical experiments in illuminating both theory and observed phenomena in the geophysical sciences are discussed. The

particular subjects are all related to the effects of the strong rotation of the earth system as a whole on the relative motions in the atmosphere and oceans or, in general, any fluid medium. First, a very simple rotating fluid system, homogeneous in density, in which the prime effects are stabilizing is discussed; next, a system in which instability motions occur that have certain similarities with natural small- and medium-scale flow patterns is considered; and finally, a few characteristics of rotating variable-density fluids driven by thermal convection, especially in cases involving time-varying behavior of a more or less realistic sort, are presented. M.P.G.

N64-24786* National Aeronautics and Space Administration, Washington, D.C.

ACTINOMETRY, ATMOSPHERIC OPTICS, AND NUCLEAR METEOROLOGY Selected Articles

W. N. Gorokhovskava et al Jun. 1964 122 p refs Transl. into ENGLISH from Tr. Konf. po Aktinometrii, Atm. Optike i Yadernoy Meteorol., Vyp. 1, Aktinometriya, Radiats. Balans. Akad. Nauk Litov. SSR Inst. Geol. i Geogr. Nauchn. Soobshch. (Vilnius), Vol. XIII, 1962
(NASA-TT-F-150) OTS: $2.75

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1. AN "ABSOLUTELY BLACK BODY" FOR THE CALIBRATION OF ACTINOMETRIC INSTRUMENTS N. N. Gorokhovskaya and E. L. Podol'skaya p 1–14 refs (See N64-24787 17-23)

2. AN ACTINOMETRIC STATION COMPOSED OF ABSOLUTE INSTRUMENTS L. V. Gul'nitskiy and I. I. Maslennikov p 15–23 refs (See N64-24788 17-15)

3. ON THE THEORY OF THE RELATION BETWEEN TOTAL RADIATION AND CLOUDINESS M. Ye. Berlyand and Ye. P. Novosel'tsev p 24–32 refs (See N64-24789 17-21)

4. CALCULATION OF TOTAL RADIATION M. S. Averkiyev p 33–41 refs (See N64-24790 17-21)

5. CALCULATION OF TOTAL RADIATION USING DATA ON CLOUDINESS K. A. Kaushila p 42–51 refs (See N64-24791 17-21)

6. CONCERNING THE THEORY OF THE VEGETATION ALBEDO Yu. K. Ross p 52–78 refs (See N64-24792 17-21)

7. THE SPECTRAL ALBEDO OF VARIOUS SURFACES IN THE VISIBLE AND NEAR-INFRARED REGIONS OF THE SPECTRUM K. Ya. Kondrat'yev, Z. F. Mironova, A. N. Otto, and V. N. Popova p 79–89 refs (See N64-24793 17-21)

8. THE ALBEDO OF THE LAND SURFACE OF THE NORTHERN HEMISPHERE V. V. Mukhenberg p 90–95 refs (See N64-24794 17-21)

9. SURFACE ALBEDO OF LAND AND SEA IN THE ARCTIC N. T. Chernigovskiy p 96–102 refs (See N64-24795 17-21)

10. THE RATIO OF SCATTERED AND TOTAL RADIATION TO THE DIRECT SOLAR RADIATION FOR THE ULTRAVIOLET AND VISIBLE PARTS OF THE SPECTRUM G. G. Sakunov and Yu. D. Yanishevskiy p 103–113 refs (See N64-24796 17-28)

11. THE MAIN CHARACTERISTICS OF THE RADIATION CLIMATE OF THE CENTRAL ARCTIC N. T. Chernigovskiy p 114–120 refs (See N64-24797 17-21)

N64-24789* National Aeronautics and Space Administration, Washington, D.C.

ON THE THEORY OF THE RELATION BETWEEN TOTAL RADIATION AND CLOUDINESS

M. Ye. Berlyand and Ye. P. Novoselitsev *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 24–32 refs (See N64-24786 17-21) OTS: $2.75

The relation between the total radiation and cloudiness is of considerable importance in the investigation of a number of actinometric problems, particularly in computing the components of the radiation balance. This article is an attempt to work out a practical, yet sufficiently rigorous method of computing the factor (coefficient characterizing the depletion due to cloudiness), based on the theory of scattering radiation in the atmosphere. G.D.B.

N64-24790* National Aeronautics and Space Administration, Washington, D.C.

CALCULATION OF TOTAL RADIATION

M. S. Averkiyev *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 33–41 refs (See N64-24786 17-21) OTS: $2.75

The method adopted for calculation of total radiation, which allows only for total cloudiness, leads to the simple formula $Q=Q_0$ (1-kn). This is used as a basis for further calculations. G.D.B.

N64-24791* National Aeronautics and Space Administration, Washington, D.C.

CALCULATIONS OF TOTAL RADIATION USING DATA ON CLOUDINESS

K. A. Kaushila *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 42–51 refs (See N64-24786 17-21) OTS: $2.75

The present rapid development of actinometry does not exclude the application of various indirect methods of calculation based on the relationship between the components of radiation balance and other climatic elements; such calculations are presented in this paper. G.D.B.

N64-24792* National Aeronautics and Space Administration, Washington, D.C.

CONCERNING THE THEORY OF THE VEGETATION ALBEDO

Yu. K. Ross *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 52–78 refs (See N64-24786 17-21) OTS: $2.75

Experimental data show that the vegetation albedo has a diurnal variation diminishing with increase in the solar altitude. This is a detailed investigation that divides the albedo A_Q for the total radiation into an albedo A_D for the scattered radiation and an albedo A_S for the direct solar radiation. Calculations are carried forth from this basis. G.D.B.

N64-24793* National Aeronautics and Space Administration, Washington, D.C.

THE SPECTRAL ALBEDO OF VARIOUS SURFACES IN THE VISIBLE AND NEAR-INFRARED REGIONS OF THE SPECTRUM

K. Ya. Kondrat'yev, Z. F. Mironova, A. N. Otto, and V. N. Popova *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 79–89 refs (See N64-24786 17-21) OTS: $2.75

A series of investigations into the spectral albedo of natural surfaces were carried out, and the results obtained are presented. The spectral albedo was measured with a sphere photometer, monochromator, FEU-22 photomultiplier, d.c. amplifier, EPP-09 electronic potentiometer, and control panel in combination. G.D.B.

N64-24794* National Aeronautics and Space Administration, Washington, D.C.

THE ALBEDO OF THE LAND SURFACE OF THE NORTHERN HEMISPHERE

V. V. Mukhenbert *In its* Actinometry, Atmospheric Optics and Nuclear Meteorol. p 90–95 refs (See N64-24786 17-21) OTS: $2.75

To improve the accuracy of the mean albedos used in earlier calculations of the absorbed radiation, the data of systematic albedo observations at actinometric stations were processed, together with the latest data obtained by scientific expeditions; these findings are presented. G.D.B.

N64-24797* National Aeronautics and Space Administration, Washington, D.C.

THE MAIN CHARACTERISTICS OF THE RADIATION CLIMATE OF THE CENTRAL ARCTIC

N. T. Chernieovskiy *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 114–120 (See N64-24786 17-21) OTS: $2.75

The results of actinometric observations at the North Pole drifting scientific stations made possible a study of the radiation climate of the Central Arctic; the radiation balance of the Central Arctic is presented. G.D.B.

N64-24799 Joint Publications Research Service, Washington, D.C.

SELECTED ARTICLES ON HYDROMETEOROLOGY

29 May 1964 58 p refs Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 4, 1964
(JPRS-24860; OTS-64-31379) OTS: $1.50

CONTENTS:

1. TRANSPORT OF RADIOACTIVE AEROSOLS IN THE TROPOSPHERE FROM THE NORTHERN TO THE SOUTHERN HEMISPHERE Yu. V. Krasnopevtsev p 1–9 refs (See N64-24800 17-21)
2. VARIABILITY OF RADIATION FACTORS OF THERMAL BALANCE OF THE EARTH'S SURFACE N. Budyko et al p 10–19 refs (See N64-24801 17-21)
3. INTERNATIONAL TRANSPORT OF DUST BY THE JET STREAM A. D. Zamorskiy p 20–24 refs (See N64-24802 17-21)
4. SELECTION OF ANALOGS WITH THE AID OF MACHINES Yu. N. Dmitriyeva and N. M. Chaplygina p 25–27 refs (See N64-24803 17-21)
5. ESTABLISHING A SINGLE CLASSIFICATION OF MACROSYNOPTIC PROCESSES IN THE NORTHERN HEMISPHERE A. A. Girs p 28–35 refs (See N64-24804 17-21)

N64-24800 Joint Publications Research Service, Washington, D.C.

TRANSPORT OF RADIOACTIVE AEROSOLS IN THE TROPOSPHERE FROM THE NORTHERN TO THE SOUTHERN HEMISPHERE

Yu. V. Krasnopevtsev *In its* Selected Articles on Hydrometeorology 29 May 1964 p 1–9 refs (See N64-24799 17-21) OTS: $1.50

An attempt was made to estimate the transport rate (through the equatorial zone) of the radioactive aerosols formed as a result of nuclear explosions in the Northern Hemisphere. During a cruise, in the period from September 20, 1961, to January 25, 1962, the concentration of artificial radioactive products in the air over the Indian and Pacific Oceans was measured. Air samples were taken on a special filter with the aid of an electric aspirator, and the common beta activity was determined. Some of the samples were subjected to a gamma spectral analysis for clarifying the isotopic structure of the captured aerosols. It is indicated that the transport rate through the equatorial zone is around 1 km/hr. I.v.L.

N64-24801 Joint Publications Research Service, Washington, D.C.

VARIABILITY OF RADIATION FACTORS OF THE THERMAL BALANCE OF THE EARTH'S SURFACE

M. I. Budyko and N. A. Yefimova *In its* Selected Articles on Hydrometeorology 29 May 1964 p 10–19 refs (See N64-24799 17-21) OTS: $1.50

Data are presented on the mean monthly and yearly totals of the radiation balance for a 10-year period, from 1952 to 1961. The mean square deviations in these values, from the 10-year norms, for individual years are given. These data, collected at Voyeykovo (Leningrad region), Vysokaya Dubrava, and Kuybyshev, indicate that the radiation factors of the heat budget of the earth's surface for individual months and years are typified by high stability and, in most instances, differ little from the mean many-years' values. Such a conclusion can by no means be extrapolated to shorter time periods, for which the mean values of total radiation and radiation balance can, depending on the weather conditions, vary appreciably. I.v.L.

N64-24802 Joint Publications Research Service, Washington, D.C.

INTERCONTINENTAL TRANSPORT OF DUST BY THE JET STREAM

A. D. Zamorskiy *In its* Selected Articles on Hydrometeorology 29 May 1964 p 20–24 refs (See N64-24799 17-16) OTS: $1.50

The passage of cold fronts over the North African deserts on March 20, 1962, and the development there of cyclonic activity, in the presence of large vertical temperature gradients, evoked not only the development of dust storms but also aided the elevation of the dust to great altitudes. This dust entered the jet stream over northern Africa, was transported to the south of the European sector of the U.S.S.R., and remained over the area from March 22 to March 23, 1962. Varying optical phenomena were caused by the dust and are discussed. I.v.L.

N64-24803 Joint Publications Research Service, Washington, D.C.

ON THE SELECTION OF ANALOGS WITH THE AID OF MACHINES

Yu. N. Dmitriyeva and N. M. Chaplygina *In its* Selected Articles on Hydrometeorology 29 May 1964 p 25–27 ref (See N64-24799 17-16) OTS: $1.50

Analogs for forecasting the synoptic processes for the current synoptic period were selected by two methods—the machine and the synoptic methods. Results of an evaluation of these two methods indicate that, at the present time, machine analogs can be used only as auxiliary aids in the choice of analogs by the synoptic method. I.v.L.

N64-24804 Joint Publications Research Service, Washington, D.C.

ON ESTABLISHING A SINGLE CLASSIFICATION OF MACROSYNOPTIC PROCESSES IN THE NORTHERN HEMISPHERE

A. A. Girs *In its* Selected Articles on Hydrometeorology 29 May 1964 p 28–35 refs (See N64-24799 17-16) OTS: $1.50

G. Ya Vangegeym's criteria for the classification of macrosynoptic processes are discussed. These criteria are: (1) allowance for the direction of the displacement of the baric formations and of the isallobaric foci in the temperature zone of the Northern Hemisphere; (2) allowance for the nature of the thermobaric long waves in the stratum of the troposphere and the lower stratosphere, their dynamics, and the related

directions of the main transports of the warm and cold air masses; (3) allowance for the direction of the horizontal baric and thermal gradients in the layer of the troposphere; (4) allowance for the distribution of the anomalies in pressure and temperature in the Northern Hemisphere, and of the process of their formation (based on integral curves of diurnal anomalies); (5) allowance for the location and intensity of the main centers of action of the atmosphere in the Northern Hemisphere; (6) indirect consideration of the thermal state of the subjacent oceanic surface and the ice pack in the arctic seas; (7) an indirect consideration of the reserves of heat and moisture in the atmosphere (by typical charts showing the distribution of the anomalies in temperature, precipitation, and cloud cover); and (8) allowance for the data on solar activity. I.v.L.

N64-24827* RAND Corp., Santa Monica, Calif.
THE SATELLITE DETERMINATION OF HIGH-ALTITUDE WATER VAPOR
E. C. May and A. B. Kahle Washington, NASA, Jul. 1964 11 p refs
(Contract NASr-21(07))
(NASA-CR-70) OTS: $0.50

Studying high-altitude water vapor by means of satellite observation of the 1.35-cm water-vapor line profile appears unfeasible. The water-vapor density distributions now expected suggest that observations of this line will seldom, if ever, show large, easily discernible peaks. Since emission from the earth also greatly reduces the line profile as seen by a satellite, ground observations seem preferable. Author

N64-24829* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROJECT FOG DROPS. INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS
James E. Jiusto Washington, NASA, Jul. 1964 68 p refs
(Contract NASr-156)
(NASA-CR-72) OTS: $1.75

Considerable fog data were examined in order to quantitatively model the structural, dynamic, and microphysical characteristics of warm fog. Laboratory experiments were conducted to determine the effect of surface active materials (fatty alcohol monolayers and ionic surfactants) on the growth and evaporation rate of droplets. These models and experimental findings were applied to the evaluation of various warm-fog modification concepts. Regions of high frequency of supercooled fog in the United States were delineated, and pertinent fog-control considerations are mentioned. Author

N64-24833* National Aeronautics and Space Administration, Washington, D.C.
THE THERMAL RADIATION OF CO_2 IN THE ATMOSPHERE [K VOPROSU TEPLOVOM IZLUCHENII UGLEKISLOGO GAZA V ATMOSFERE]
K. Ya. Kondrat'yev and Kh. Yu. Niylisk Jul. 1964 24 p refs Transl. into ENGLISH from Probl. Fiz. Atmosfery, SB. 2, Izd. Leningrad. Univ., 1963 p 28–47
(NASA-TT-F-208) OTS: $0.75

The purpose of this article is to determine absorption (transmission) functions of the atmosphere in the 12μ to 18μ region on the basis of modern theoretical and experimental data and to apply the obtained absorption (transmission) functions to investigation of the thermal flux of CO_2 as dependent on different factors (changes of CO_2 and H_2O concentration in the atmosphere, thermal stratification of the atmosphere, etc.). Author

N64-24906* Electro-Optical Systems, Inc., Pasadena, Calif.
MEASUREMENT OF FREE AIR PROPERTIES FROM ONBOARD A LARGE LAUNCH VEHICLE
Glenn Cato [1964] 13 p refs Presented at AIAA First Ann. Meeting and Tech. Display, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contract NAS8-5226)

A study was conducted of techniques to measure the temperature, pressure, density, and wind velocity about 30 km onboard a large launch vehicle. The purpose of the measurement is to obtain a more complete picture of the environment during the flight test of Apollo and Gemini launch vehicles than is possible with measurements made within the shock layer. Results of the study indicate that the most promising technique is remote measurement. However, the only property that is readily amenable to onboard remote measurement is density. Consequently, recommendations for immersion-type measurements of the other properties were formulated. If forward locations for the immersion-type instruments cannot be made available, then free-flight or dropsonde techniques must be adopted. Recommendations for dropsonde techniques were formulated. I.v.L.

N64-24947 Colorado State U., Fort Collins
CUMULUS CONVECTION AND OROGRAPHIC CONVECTION CELLS
Herbert Riehl [1963] 18 p
(Contract DA-36-039-SC-89080(E))
(TR-3; AD-435631)

Preliminary research in regard to southeast Asian regions is described under two topics—onset of the Asian summer monsoon and studies of monsoon cloud and weather patterns. Calendar dates for the commencement of the SW monsoon continue for the years 1942 through 1949. Daily variation of the wind, rainfall, and pressure patterns was analyzed from August 1961 through October 1961. TIROS III pictures and radiation data are assisting in understanding the weather developments for this period. The conventional data at 500 mb appears to show more character than lower or high levels, in relation to existing weather (i.e., rainfall). Author

N64-25032 Meteorology International Inc., Monterey, Calif.
SCALE-AND-PATTERN SPECTRA AND DECOMPOSITIONS
Manfred M. Holl 1 Nov. 1963 31 p refs
(Contract N228-(62271)-60550)
(TM-3; AD-437656)

A technique to objectively and quantitatively represent the contribution made to a scalar distribution by recognizable and characteristic patterns, which lie in the distribution, is presented. A new representation of the spectrum of a field is defined; and a technique for analyzing this spectrum and for decomposing the field into additive indigenous component fields is developed. R.T.K.

N64-25119* Geophysics Corp. of America, Bedford, Mass.
AN EXPERIMENTALLY DETERMINED MODEL FOR THE PERIODIC CHARACTER OF WINDS FROM 85 TO 135 KM
E. Manring, T. Bedinger, H. Knaflich, and D. Layzer Washington, NASA, Jul. 1964 114 p refs
(Contract NASw-712)
(NASA-CR-36) OTS: $2.50

Since 1959, measurements of upper atmosphere winds have been made from Wallops Island, Virginia, utilizing the sodium vapor technique. To date, measurements from 22 different vapor

trails have been analyzed. In the height range 85 to 135 km, the measurements show that the winds have large quasi-periodic components. Analysis shows that the 8-hr component is dominant over the entire range. A new picture of the wind structure at these altitudes is proposed. Author

N64-25249 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, AEROBEE AD 3.152
Marjorie Mc Lardie Hoidale Mar. 1964 39 p refs
(ERDA-120; AD-442765)

Meteorological data gathered for the launching of Aerobee AD 3.152 are presented for ballistic studies; calculated ballistic data are also presented. Author

N64-25250 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, AEROBEE AC 3.513
Marjorie Mc Lardie Hoidale Mar. 1964 40 p refs
(ERDA-121; AD-442764)

Meteorological data gathered for the launching of Aerobee AC 3.513 are presented for ballistic studies; calculated ballistic data are also presented. Author

N64-25251 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, NIKE-APACHE SR-016
Marjorie Mc Lardie Hoidale Mar. 1964 33 p refs
(ERDA-123; AD-442763)

Meteorological data gathered for the launching of Nike-Apache SR-016 are presented for ballistic studies; calculated ballistic data are also presented. Author

N64-25252 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, AEROBEE ND 3.143
Marjorie McLardie Hoidale Mar. 1964 38 p refs
(ERDN-124; AD-442762)

Meteorological data gathered for the launching of Aerobee ND 3.143 are presented for ballistic studies; calculated ballistic data are also presented. Author

N64-25322 Emmanuel Coll., Boston, Mass. Research Language Center
METHODS OF CLOUD DISSIPATION OVER LARGE AREAS [METODIKE RASSEIANIIA OBLAKOV NA BOL'-SHIKH PLOSHCHADIAKH]
V. I. Beliaev, I. S. Pavlova, and V. M. Riabov Bedford, Mass., AFCRL, Feb. 1964 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 9, 1963 p 1410–1416
(Contract AF 19(604)-8505)
(E-T-R-64-17; AD-601209)

This article is concerned with a preliminary discussion of the problems involved with devising a method of cloud dissipation over areas greater than 10 km^2. When selecting the dosages of dry ice to be used in the seeding of large areas, the behavior of the entire cloud mass rather than that of a single seeded band is considered. Author

N64-25364 George Washington U., Washington, D.C. Human Resources Research Office
MOONLIGHT AND NIGHT VISIBILITY RESEARCH MEMORANDUM
Thomas F. Nichols and Theodore R. Powers Jan. 1964 58 p refs
(Contract DA-44-188-ARO-2)
(AD-438001)

This report presents a summary and discussion of published data and information relevant to visibility under low levels of natural illumination. Those changes that occur in the nature and intensity of light between sunset and sunrise are described and related to the visibility of objects of military significance. Six field studies of night target detection are reviewed and assessed as to comprehensiveness in terms of a set of factors that affect visual perception. Suggestions for future research are offered, and procedures for the preparation of moon diagrams and charts, which provide comprehensive information on the potential availability of moonlight, are described. I.v.L

N64-25375 Hawaii Inst. of Geophysics, Honolulu Meteorology Div.
THE UTILIZATION OF TIROS PICTURES TO SOME SELECTED STUDIES OF TROPICAL METEOROLOGY Final Report
Ronald C. Talor Apr. 1964 18 p refs
(Contract AF 19(604)-6156)
(HIG-64-5; AFCRL-64-327; AD-601905)

Summaries of the following reports are presented: (1) Tiros I Observations of a Subtropical Cyclone; (2) Cloud Patterns in a Tropical Cyclone in the Arabian Sea Viewed by Tiros I Meteorological Satellite; (3) The Diurnal Variation of Summer Rainfall over Malaya; (4) Tropical Cyclones of the Eastern North Pacific as Revealed by Tiros Observations; and (5) Tiros Observations of the Summer Circulation and Weather Pattern of the Eastern North Pacific. I.v.L

N64-25504 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, NIKE-APACHE SR-017
Gordon L. Dunaway Apr. 1964 36 p
(ERDA-133; AD-442745)

Meteorological data gathered for the launching of Nike-Apache SR-017 are presented for ballistic studies; calculated ballistic data are also presented. Author

N64-25505 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
METEOROLOGICAL DATA REPORT, AEROBEE BIRA-01, 16 MARCH 1964
Marjorie Mc Lardie Hoidale Apr. 1964 38 p refs
(ERDA-134; AD-442746)

Meteorological data gathered for the launching of Aerobee BIRA-01 are presented for ballistic studies; calculated ballistic data are also presented. Author

N64-25517 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
NIKE-APACHE SPEEDBALL II, METEROLOGICAL DATA REPORT
Len E. Carter and Gordon L. Dunaway Apr. 1964 48 p
(ERDA-135; AD-442747)

Meteorological data gathered for the launching of Nike-Apache Speedball II, and the resulting ballistic data are presented. The meteorological data may also be used for future ballistic studies. Author

N64-25535 Joint Publications Research Service, Washington, D.C.
NEW METHODS OF MEDIUM RANGE WEATHER FORECASTING
E. C. Kalman 17 Jul. 1964 3 p refs Transl. into ENGLISH from Ido-Jaras (Budapest), v. 67, no. 6, Nov. 1963 p 372–376
(JPRS-25509; TT-64-31781) OTS: $0.50

A new method for medium-range forecasting is discussed. The following charts are necessary to prepare a forecast for 3 to 7 days using this method: (1) ground-proximity synoptic charts; (2) absolute topographies of the principal isobar surfaces; and (3) a chart of the 500/1,000 mb relative geopotential. Auxiliary charts are prepared from the absolute topographies. These are as follows: mean charts relating to the various time periods, isallohypsa charts, and turbulence charts of various levels. The following charts are based on the 500/1,000 relative topography: the various mean shifts, the isallohypsa charts, and the daily charts of the deviations from the mean of a large number of years. I.v.L.

N64-25719 Joint Publications Research Service, Washington, D.C.
A THEORETICAL MODEL OF WEATHER FORECASTING
G. I. Marchuk 8 Jul. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 5, 11 Apr. 1964 p 1062–1065
(JPRS-25398; TT-64-31671) OTS: $0.50

A mathematical model of atmospheric processes is constructed that is based on a great number of diverse physical factors—boundary conditions at the surface of the earth, at the level of the underlying surface (seas and oceans), and the upper boundary of the atmosphere—that have essential significance for weather formation. The model more fully reflects the main features of the evolution of fields of meteorological elements in a three-dimensional baroclinic atmosphere. The system of differential equations constructed approximates to the initial differential equations with an accuracy of up to the magnitude of the first order of smallness with respect to $\alpha = 1\Delta t$, where α is the radiation transfer and Δt is a time interval, and it is stable from the standpoint of calculation. The equations of radiation transfer are solved by an approximation of the method of spherical harmonics. Thus, the problem of forecasting fields of meteorological elements is broken down into a sequence of elementary algorithms effectively realized by computers. I.v.L.

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-24597 Joint Publications Research Service, Washington, D.C.
INFRARED EQUIPMENT FOR MISSILE HOMING
L. Z. Kriksunov and I. F. Usol'tsev 4 Jun. 1964 232 p refs Transl. into ENGLISH of the book "Infrakrasnyye Ustroystva Samonavedeniya Upravlyayemyka Snaryadov", Moscow p 1-240
(JPRS-24947; OTS-64-31416) OTS: $3.50

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1. GENERAL INFORMATION CONCERNING HOMING SYSTEMS FOR GUIDED MISSILES p 3–20 (See N64-24598 17-22)
2. OPERATING PRINCIPLES OF OPTICAL (INFRARED) TARGET SEEKERS p 21–62 (See N64-24599 17-22)
3. TRACKING TARGET SEEKERS p 63–79 (See N64-24600 17-22)
4. RADIANT ENERGY DETECTORS p 80–123 (See N64-25601 17-15)
5. OPTICAL SYSTEMS OF TARGET SEEKERS p 124–145 (See N64-25602 17-15)
6. DETERMINATION OF THE MAGNITUDE OF ENERGY RADIATED BY A TARGET AND TAKEN UP BY THE DETECTOR OF A TARGET SEEKER p 146–173 (See N64-25603 17-22)
7. TESTING OF INFRARED HOMING DEVICES p 174–218 (See N64-25604 17-22)

N64-24598 Joint Publications Research Service, Washington, D.C.
GENERAL INFORMATION CONCERNING HOMING SYSTEMS FOR GUIDED MISSILES
In its Infrared Equipment for Missile Homing 4 Jun. 1964 p 3–20 (See N64-24597 17-22) OTS: $3.50

The basic principles of the guidance systems employed in guided missiles are discussed. Designation of the principal elements in homing systems, the operating principles and basic elements of optical (infrared) target seekers, homing methods, and methods of installing a target seeker in a missile are included. P.V.E.

N64-24599 Joint Publications Research Service, Washington, D.C.
OPERATING PRINCIPLES OF OPTICAL (INFRARED) TARGET SEEKERS
In its Infrared Equipment for Missile Homing 4 Jun. 1964 p 21–62 (See N64-24597 17-22) OTS: $3.50

The theory and working principles of three types of optical (infrared) target seekers are discussed in detail: (1) target seekers based on the frequency principle—components of the misalignment angle on each of the control surfaces of the missile determined by the frequency modulation of a radiant flux; (2) target seekers based on the phase principle—misalignment angle determined by the magnitude of the phase shift of the photocurrent signals, which is caused by the relationship between the radiation of the target and a "reference" signal; and (3) target seekers based on the pulse-time principle—misalignment angle determined by the duration of a pulse in the infrared detector circuit, caused by the effect of the target's radiation. P.V.E.

N64-24600 Joint Publications Research Service, Washington, D.C.
TRACKING TARGET SEEKERS
In its Infrared Equipment for Missile Homing 4 Jun. 1964 p 63–79 (See N64-24597 17-22) OTS: $3.50

The various components of tracking target seekers are described, and the principles of assembling the components are discussed. Several specific optical tracking target seeker systems are also discussed. P.V.E.

N64-24603 Joint Publications Research Service, Washington, D.C.

DETERMINATION OF THE MAGNITUDE OF ENERGY RADIATED BY A TARGET AND TAKEN UP BY THE DETECTOR OF A TARGET SEEKER

In its Infrared Equipment for Missile Homing 4 Jun. 1964 p 146–173 (See N64-24597 17-22) OTS: $3.50

The magnitude of the energy, radiating from a target, that is taken up by the detector of a target seeker is calculated. Four laws that are used in the calculations are discussed briefly: Planck's law, the Stefan–Boltzmann law, Wien's law, and Lambert's law. P.V.E.

N64-24604 Joint Publications Research Service, Washington, D.C.

TESTING OF INFRARED HOMING DEVICES

In its Infrared Equipment for Missile Homing 4 Jun. 1964 p 174–218 (See N64-24597 17-22) OTS: $3.50

The basic criterion affecting the efficiency of IR homing devices is the minimum signal that can be detected by them. This signal is limited by noise masking the useful signal, so that the most important factor characterizing the efficiency of the device is the signal–noise ratio. Two basic causes of noise in IR homing devices are discussed: (1) the heterogeneity of the radiation emanating from the atmosphere, background of the sky, or ground against which the target is being tracked; and (2) set noises, distributed in time, occurring in electronic circuits and in mechanical vibrations, or in the operation of the automatic target tracking system. P.V.E.

N64-24830* Martin Co., Baltimore, Md.

THE USE OF MAN IN BOOSTER GUIDANCE AND CONTROL

F. A. Muckler and R. W. Obermayer Washington, NASA, Jul. 1964 338 p refs

(Contract NASw-718)

(NASA-CR-81) OTS: $1.00

The manned booster guidance and control literature is reviewed and analyzed with regard to basic guidance and control objectives. The present literature strongly suggests that pilot-booster performance will be a function of the following: the pilot's position in the control loop; the degree of vehicle perturbations and the stability of the booster configuration; the nature of the information displayed to the pilot; the effect of additional task loading on the pilot; and the effects of environmental events occurring during boost. An evaluation of manned booster guidance and control is made on the basis of five criteria—stability, response efficiency, reliability, adaptability, and acceptability. Author

N64-24883 Lockheed Missiles and Space Co., Sunnyvale, Calif.

TERMINAL GUIDANCE SYSTEMS: A SELECTIVE BIBLIOGRAPHY

George R. Evans, comp. Mar. 1963 66 p refs

(Contract NOw-63-0050-C)

(SB-63-34; Rept.-8-40-63-7; AD-441577)

Terminal guidance systems discussed in this compilation are varied in theory and design and are employed in the terminal phase of several types of missions. Design considerations include radar and heat homing devices, optical systems, infrared systems, and inertial and celestial systems. Missions include guided missiles, surface-to-surface, surface-to-air, and air-to-air; orbital rendezvous of satellite vehicles; and lunar and planetary entry of space vehicles. Author

N64-24887* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

MOVING-ARC DATA SMOOTHING FOR FLIGHT-ANALYSIS PROGRAMS

Thomas S. Logsdon New York, AIAA [1964] 13 p refs Presented at the 1st AIAA Ann. Meeting, Washington, 29 Jun.–2 Jul. 1964

(Sponsored in Part by NASA)

(AIAA Paper-64-324) AIAA: $0.50 members, $1.00 nonmembers

A generalized derivative-constrained moving-arc smoothing method is developed and shown to yield a highly desirable combination of smoothness and accuracy when applied to vehicle tracking and telemetry data. Derivations and comparisons of the derivative-constrained and polynomial smoothing methods are presented, together with a nonsymmetrical endpoint smoothing formula, a matrix method of performing multiple-pass smoothing, and a definitive relationship between the derivative-constrained and the polynomial methods. Since bad data points can corrupt smoothing processes, a method for their detection and replacement is developed employing extrapolations of the smoothing arc. Smoothing across transients is undesirable because it tends to distort and suppress them. For this reason, a companion method of distinguishing between bad data points and actual transients is presented. The final scheme, in a single pass through the data, detects and replaces the bad data points, detects and skips over transients, and gives smoothed values for all inputs. Author

N64-24963* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

LUNAR LANDING AND LONG-RANGE EARTH RE-ENTRY GUIDANCE BY APPLICATION OF PERTURBATION THEORY

Henry C. Lessing, Phillips J. Tunnell, and Robert E. Coste Repr. from J. Spacecraft and Rockets, v. 1, no. 2, Mar.–Apr. 1964 p 191–196 refs Presented at the AIAA–NASA 2nd Manned Space Flight Meeting, Dallas, 22–24 Apr. 1964

(NASA-RP-209)

A guidance scheme based on linear perturbation theory was investigated. An improved capability was achieved by the proper choice of independent variable and by appropriate weighting of the guidance gains computed by linear theory. The capability of this scheme applied to the descent-to-hover phase of lunar landing is demonstrated for two different types of nominal trajectory: a constant-thrust gravity turn maneuver, and a constant-thrust, constant-pitch-rate maneuver. To demonstrate the performance of this type of guidance scheme for atmosphere entry, it was applied to the guidance of a vehicle entering the earth's atmosphere at parabolic velocity. Its capability is evaluated for entries from abort conditions, as well as for entries within the normal entry corridor, and effects of variations in life-drag ratio and atmospheric density are investigated. It is shown that for both lunar landing and atmosphere entry this guidance system, which uses a single nominal trajectory, and therefore requires minimum storage capacity, permits guidance to a selected landing site from a wide range of initial conditions. Author

N64-25068 Federal Aviation Agency, Washington, D.C. Program Control Div.

AIR TRAFFIC PATTERNS AND COMMUNITY CHARACTERISTICS

A. D'Arcy Harvey and Jesse L. Sternberger, Jr. [1963] 52 p

The FAA has found it necessary to use more than the population size of a community as a basis for planning and programing in the aviation field of responsibility. The character of a community is a good determinant factor of a community's

aeronautical activity. This report discusses the relationships between air traffic patterns and community characteristics by describing air traffic hubs, size and economy of the community, and employment features. G.D.B.

N64-25072 Federal Aviation Agency, Atlantic City, N.J. Research Div.
INVESTIGATION OF ADVANCED SEQUENCING AND CONTROL CONCEPTS IN AN AUTOMATED TERMINAL ENVIRONMENT. VOLUME I—SIMULATION STUDIES Final Memorandum Report
R. S. Pardee, D. Scheffler, F. Holland, E. A. Robin (TRW Computers Co.), A. G. Halverson et al Apr. 1963 235 p

This report pertains to simulation studies carried out under the Terminal Area Research (TAR) Project. The basic objective of these studies was to evaluate the general utility of digital computer techniques as an aid to air traffic management process under advanced terminal area sequencing and control concepts. Three principle techniques for applying digital computers to effect precise control in the spacing and movement of aircraft were examined and are reported—arrival aircraft time-to-turn countdown procedures, a go-no-go computation procedure to assist utilization, and a time-to-turn countdown procedure for precise time–altitude delivery of departure aircraft at the first enroute fix. G.D.B.

N64-25084 Michigan U., Ann Arbor Inst. of Science and Technology
STUDY AND ANALYSIS OF POSITION DATA ACQUISITION TECHNIQUES FOR OVER-OCEAN AIR TRAFFIC CONTROL Final Report, Apr. 1962 – Apr. 1963
Lyle D. Filkins, Joseph W. Little, James O'Day, and Robert E. Scott Dec. 1963 256 p refs
(Contract FAA/ARDS-506)
(Rept.-5088-12-F; RD-64-6; AD-435570)

A study of techniques for supplying positional data on aircraft traversing oceanic areas to an air traffic control system was conducted. The purpose of the study was to determine which techniques might be technically feasible during the time period from the present to 1975. The conclusions are as follows: (1) Hybrid navigation systems presently available will determine the position of an airplane with acceptable accuracy, but a considerable improvement in longrange air-to-ground communications (probably achievable only by a synchronous satellite system) must occur before an advanced reported air-observed position determination system can be implemented. (2) A network of shipborne Rho-Theta observation units is technically capable of immediate implementation for the North Atlantic minimum time path envelope between New York and London (or any similar route), but a number of operational and other nontechnical problems must be solved before this approach could be recommended. (3) High-frequency techniques are unacceptable for this application. (4) A dual ranging technique utilizing synchronous equatorial-orbit satellites is potentially capable of excellent performance. A system utilizing this technique is synthesized and discussed in the report. Author

N64-25096 Federal Aviation Agency, Atlantic City, N.J. National Aviation Facilities Experimental Center
OPERATION ACCORDION—NAVIGATIONAL ACCURACIES OF CIVIL JET AIRCRAFT OVER THE NORTH ATLANTIC, FEBRUARY 1962–SEPTEMBER 1963, VOLUME I Final Report
Irving Hirsch, Ronald Braff, and O. Marie Des Rosier Apr. 1964 454 p refs
(RD-64-52, I)

This report presents navigational accuracies over the North Atlantic during February 1962 through September 1963. The results are based upon data collected from approximately 5,000 Accordion designated civil jet flights of 14 participant airlines. The measurements were made by four radars, viz. Gander, Goose, OSV Charlie, and Killard. In addition, considerable quantities of data were supplied by the airlines from Accordion flight logs. The administration of Operation Accordion comprised a condominium of the United States, the United Kingdom, and Canada. The primary purpose of the program was to provide information for decisions on current requirements for horizontal separation standards. Subordinate objectives included the procurement of information concerning the effects of different operational and external environments upon navigational accuracy. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-24326 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE NATURE OF GRAVITATION
V. V. Radziyevskiy and I. I. Kagal'nikova 8 May 1964 25 p refs Transl. into ENGLISH from Byull. Vsesoyuz. Astronomo-Geod. Obshchestva (Moscow), no. 26, 1960 p 3–14
(FTD-TT-64-323/1+2+4; AD-601762)

The hypothesis of Lomonosov and Lesage, that gravitational effects are caused by "ultracosmic" particles that penetrate all matter and give up momentum in passage, is discussed at length. It is claimed that the modernized hypothesis is not in conflict with any experimental facts. D.E.W.

N64-24330 Naval Ordnance Test Station, China Lake, Calif.
INITIATION OF EXPLOSIVES THROUGH METAL BARRIERS
L. N. Cosner and R. G. S. Jewell Apr. 1964 11 p refs Presented at the Detonation Wave Shaping Conf., Jun. 1956, Pasadena, Calif.
(NAVWEPS-8507; NOTS-TP-3489, AD-600900)

Two cylindrical explosive charges separated by steel discs of varying thicknesses were used in a series of tests in which one explosive charge was detonated to obtain a low-order detonation wave in the explosive charge on the opposite side of the steel disc. The acceptor charge showed that as the plate thickness increased, the length of travel of the low-order wave and the time to high-order detonation increased. No high-order detonation occurred where an explosive-to-metal length ratio of greater than 3:2 was used. When the high-order detonation wave traveled back through the region traversed by the low-order wave the velocity showed a slight decrease from stable high-order detonation velocity, but the decrease did not appear to be significant. Author

N64-24336 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
A PROPOSED X-RAY-INFRARED METHOD FOR IDENTIFICATION OF ATMOSPHERIC MINERAL DUST
Teddy L. Barber Jun. 1964 19 p refs
(ERDA-141; AD-601707)

An experimental technique is presented for the identification of the major mineral constituents in small samples of atmospheric particulates. Each sample is divided into two parts—one is examined by X-ray powder diffraction at two

wavelengths, copper and chromium Kα, and the other is examined by infrared absorption. With this combination it has been possible to extend component crystalline mineral identification down to 1 mg of total sample. Author

N64-24387 Technical Research Group, Inc., Melville, N.Y.
FANTASIA II AND TRIPROD II—SHIELDING CODES FOR THE IBM 7090 Technical Documentary Report, Mar. 1962–Nov. 1962
Herbert A. Steinberg and Raphael Aronson Wright-Patterson AFB, Ohio, AF Materials Lab., Apr. 1964 77 p refs
(Contract AF 33(657)-8277)
(ML-TDR-64-52; AD-601012)

Two codes have been developed for the IBM 7090. Fantasia II computes neutron transmission through laminated slab shields and slowing down density within the shields by Monte Carlo methods. Triprod II is a slowing down code suitable for shielding problems. These codes are based on Fantasia and Triprod, shielding codes for the 1103A Univac. Operating instructions are included. Author

N64-24395 National Academy of Sciences–National Research Council, Washington, D. C.
NUCLEAR THEORY REFERENCE BOOK FOR 1961 AND 1962. COMPILATION OF NUCLEAR THEORY INDEX CARDS
R. Nakasima and H. Ogata, ed. Dec. 1963 175 p refs
(Sponsored by AEC) GPO: $1.25

N64-24398* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS, 1. THE PHOTOIONIZATION OF ATOMIC OXYGEN
A. Dalgarno, R. J. W. Henry, and A. L. Stewart Washington, NASA, Jul. 1964 23 p refs Submitted for Publication Previously Published as NASA-CR-55949; See N64-17689 09-23
(Contract NASw-840)
(NASA-CR-66; NASA-CR-55949) OTS: $0.75

The formulation of a Hartree–Fock approximation for the final states of a transition involving the ejection of an outer or an inner shell electron from all ground state configurations $1s^2\ 2s^2\ 2p^q$ is presented. The cross sections for the photoionization of atomic oxygen by radiation at wavelengths longer than 25 A are calculated. Author

N64-24399 Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS III: PHOTOIONIZATION CROSS SECTIONS OF THE RARE GASES
J. A. R. Samson and F. L. Kelley Washington, NASA, Jul. 1964 73 p refs Previously Published as NASA-CR-55940; See N64-17671 09-23
(Contract NASw-840)
(NASA-CR-68) OTS: $2.00

The photoionization cross sections of the rare gases have been measured from their ionization thresholds to 280 A. Published and unpublished data have been compiled and tabulated. In the case of He, Ne, and A the tabulated data essentially provide absorption coefficients continuously from threshold to 0.01 A. Although continuous data for the K-shell are tabulated down to 0.01 A for Kr and Xe, there is very little information available for the remaining inner shells. The oscillator strengths for excitations into the photoionization continuum are discussed. It is shown, in the case of helium, that knowledge of the total continuum oscillator strength in conjunction with the Thomas–Kuhn sum rule provides immediately the total discrete f-numbers. For this approach, however, it is necessary to know the values of the absorption coefficients to a high degree of accuracy. A summary of the continuum f-numbers shell by shell is given in a table. For the K-shells the f-numbers were evaluated down to 0.01 A. The contributions to the outermost shells include the f-numbers of the Beutler lines. Author

N64-24513 Joint Publications Research Service, Washington, D.C.
MOTIONS IN AN OPTIMIZING SYSTEM WITH SENSITIVITY CONTROL
B. A. Aref'yev *In its* Izv. VUZov: Instr. Bldg. 7 May 1964 p 56–69 refs (See N64-24506 17-09) OTS: $3.50

This paper presents a study of the motions of an optimizing system with a linear controller whose actuator speed is proportional to the sensitivity of the controlled object. It is assumed that the inertial portion of the object is downstream of its nonlinear portion. Author

N64-24564 Joint Publications Research Service, Washington, D.C.
LUMINESCENCE, IONIZATION AND RADIATION PHYSICS
29 May 1964 62 p refs Transl. into ENGLISH of Eight Articles from Nauchn. Tr., Fiz., (Tashkent), no. 22, 1963 p 45–52, 71–83, 128–135, 145–148, 180–196
(JPRS-24842; OTS-64-31368) OTS: $1.50

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2. PREPARATION OF PHOSPHORS BASED ON $CaSO_4$ A. R. Krasnaya, L. S. Revzin, and V. Ya. Yaskolko p 11–19 refs (See N64-24566 17-07)

3. EFFECT OF VARIOUS ACTIVATORS ON THE EXOELECTRONIC EMISSION OF $CaSO_4$ A. R. Krasnaya, and V. Ya. Yaskolko p 20–22 refs (See N64-24567 17-23)

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5. ON THE MECHANISM OF INTERACTION OF SLOW POSITIVE IONS FROM THE SURFACE OF A METAL V. I Veksler p 26–34 refs (See N64-24569 17-23)

6. EVAPORATION OF GOLD FROM THE SURFACE OF GRIDS AND CROSSARMS AND ITS DISTRIBUTION ON ELEMENTS OF A RADIO TUBE WITH AN OXIDE CATHODE A. D. Naroditskiy, L. M. Mikiforova, M. G. Khalulin, and D. A. Khashbaktiyeva p 35–38 refs (See N64-24570 17-09)

7. PULSE HIGH-FREQUENCY ION SOURCE WITH SHOCK EXCITATION G. A. Gumanskiy and V. V. Skvortsov p 39–42 refs (See N64-24571 17-09)

8. VOLTAMPERE CHARACTERISTICS OF AN RECTIFIER OF THE p-p-n STRUCTURE IN A STRAIGHT LINE AT A HIGH LEVEL OF INJECTION R. Mamathkulov p 43–54 refs (See N64-24572 17-09)

N64-24565 Joint Publications Research Service, Washington, D.C.
LIGHT AND ELECTRICAL CHARACTERISTICS OF PHOTORESISTANCES BASED ON CdS
I. S. Andreyev, G. B. Arzumanyan, and R. F. Belyalova *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 1–10 refs (See N64-24564 17-23) OTS: $1.50

Photoresistances made from powdered CdS are pressed plates (more frequently disks) 0.8 to 1 mm thick, that are subjected to special thermal treatment. The physical properties of the obtained photoresistances depend chiefly on the concentration of the activators and coactivators as well as on the thermal treatment conditions and on the gaseous medium in which

treatment is conducted. Changes in the parameters of photoresistances, such as the dark conductivity, integral sensitivity, spectral sensitivity, and inertia due to variation in these conditions, are discussed. N.E.A.

N64-24567 Joint Publications Research Service, Washington, D.C.
EFFECT OF VARIOUS ACTIVATORS ON THE EXOELECTRONIC EMISSION OF $CaSO_4$
A. R. Krasnaya and V. Ya. Yaskolko *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 20–22 refs (See N64-24564 17-23) OTS: $1.50

Results are reported from the investigation on the thermostimulated exoelectronic emission of phosphors based on CaSO with the activators Ba, Zn, Cd, Ni, Bi, Pb, Mn, and Sm. Measurements were conducted with the aid of a spark meter that automatically records the counting rate. The phosphors were irradiated by the Sr-90 data source. An analysis of the obtained data is presented. N.E.A.

N64-24568 Joint Publications Research Service, Washington, D.C.
THERMOLUMINESCENCE OF $CaSO_4$·Mn, $CaSO_4$·Sm, AND $CaSO_4$·Sm-Mn
S. N. Kulakova and V. Ya. Yaskolko *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 23–25 refs (See N64-24564 07-23) OTS: $1.50

The results of the measurements of thermoluminescence of phosphors based on $CaSO_4$ containing the activators Mn and Sm are presented. The thermoluminescence was measured on a photometric device equipped with the photomultiplier FEU-33; thermoluminescence curves and the thermocouple current were recorded on photopaper; the light sum was measured by electrointegration. N.E.A.

N64-24569 Joint Publications Research Service, Washington, D.C.
ON THE MECHANISM OF INTERACTION OF SLOW POSITIVE IONS FROM THE SURFACE OF A METAL
V. I. Veksler *In its* Luminescence, Ionization and Radiation Phys. 29 May 1964 p 26–34 refs (See N64-24564 17-23) OTS: $1.50

The maximum energies of the Rb^+ and Cs^+ ions reflected from the surface of molybdenum are determined by the scattering of these ions from four atoms of the lattice on which the effect of other atoms of the lattice is placed at low energies of interaction. These results make it possible to estimate certain characteristics of the colliding particles. N.E.A.

N64-24595 Boeing Scientific Research Labs., Seattle, Wash. Mathematical Research Lab.
MOTION IN THE VICINITY OF THE TRIANGULAR LIBRATION CENTERS Mathematical Note No. 338
André Deprit Oct. 1963 42 p refs
(DI-82-0335; AD-439214)

For the planar restricted problem of three bodies in the neighborhood of triangular equilibrium, angle coordinates and action moments are derived, which normalize the second-order part of the Hamiltonian function. Consequently, short- and long-period elliptic oscillations of the first order can be extended into two families of periodic motions that exhibit the Dalembert characteristic, except for a denumerable set of critical mass ratios for which the long-period librations are in resonance with the short-period oscillations. For the Sun–Jupiter and Earth–Moon systems, terms up to the third order with regard to the orbital parameter have been computed and checked for the Fourier series of both families of periodic orbits. Author

N64-24605 Oak Ridge National Lab., Tenn.
KINEMATICS NOMOGRAM FOR LOW-ENERGY NUCLEAR REACTIONS
J. K. Dickens Jun. 1964 29 p refs
(Contract W-7405-ENG-26)
(ORNL-3636) OTS: $0.75

For given particles a, b in the nuclear two-body reaction X(a,b)Y, the nomogram described in this report solves the nonrelativistic kinematics relation $Q = E_b(1 + M_b/M_Y) - E_a(1 - M_a/M_Y) - 2 \cos \theta (M_a M_b E_a E_b)^{1/2}/M_Y$ for any one of the variables Q, E_a, E_b, θ, and M_Y in terms of the others. Nomograms are presented for the reactions (p,p'), (p,d), (p,t), (p,α), (d,d), (d,p), (^{3}He,d), (α,α), (α,p), (^{16}O,^{16}O), and (^{16}O,α); the FORTRAN program used to plot them is included. Author

N64-24684 Oak Ridge National Lab., Tenn.
ELASTIC AND INELASTIC SCATTERING OF 5- TO 13.5-MeV DEUTERONS FROM Ni^{60}: TABULATED DIFFERENTIAL CROSS SECTIONS
J. K. Dickens and F. G. Perey Jun. 1964 18 p refs
(Contract W-7405-ENG-26)
(ORNL-3637) OTS: $0.50

Angular distributions for elastic scattering of deuterons from Ni^{60} have been measured for incident deuteron energies of 4.86, 5.86, 6.87, 7.88, 8.88, 9.89, 10.86, 11.92 and 13.56 Mev. Differential cross sections were obtained at 5° intervals between laboratory angles of 30° and 160°. Cross sections for deuterons inelastically scattered from the first excited state of Ni^{60} (Q = −1.33 Mev) were obtained for the four incident deuteron energies between 9.89 and 13.56 Mev listed above. Numerical values for all measured cross sections are tabulated. Author

N64-24757 Uppsala U. (Sweden)
THE STRUCTURE OF FERMION DENSITY MATRICES.—II. FUNCTIONS OF BCS TYPE AND SUPERCONDUCTIVITY
A. J. Coleman 1 Aug. 1963 42 p refs
(Contract AF 61(052)-351)
(TM-103; ARL-63-214; AD-422538)

The first- and second-order reduced density matrices are calculated for wave functions of the Bardeen-Cooper-Schrieffer type, and the statistics of pairs of fermions is discussed. A new criterion for the onset of superconductivity is proposed, which appears to be consistent with the evidence for the BCS theory, but is based on the total Hamiltonian of the lattice. Author

N64-24758 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
OPTICAL MEASUREMENTS ON CONES AND CYLINDERS
R. C. Bartle, C. I. Beard, and J. E. Burke 1 Nov. 1964 50 p refs
(Contracts DA-36-039-AMC-00088(E); DA-36-039-AMC-03404(E))
(EDL-M614; AD-601477)

The results of a series of laboratory measurements of the intensity of light reflected from cylinders, cones, and frustums of cones are summarized and compared with theoretical calculations. Targets of various lengths are considered for angles of incidence ranging from near-normal to near-grazing. In addition, the use of small receiving apertures, photographs, and densitometer readings, for investigating some of the effects of surface conditions, is illustrated. Author

N64-24785 Cornell U., Ithaca, N.Y. School of Electrical Engineering
INVESTIGATION OF LINEAR BEAM AND NEW CONCEPTS OF MICROWAVE POWER GENERATION
Griffiss AFB, N.Y., RADC, May 1964 78 p refs
(Contract AF 30(602)-3243)
(RADC-TDR-64-140, Vol. 1; AD-601154)

In the fundamental studies of electron beams, the propagation of a 3000-mc space-charge wave was investigated along a periodically varying electron beam, the d.c. behavior of which is accurately known. Measured gain rates are in good agreement with those predicted by the theory of scalloped-beam amplification. In the beam-circuit interaction area, progress was made on computations of the effects of distributed interaction circuits and biased gaps on the efficiency of two-cavity klystrons. The nanosecond pulse study is concerned with the response of microwave amplifiers to short pulses of the order of a few RF cycles long. Study was concentrated on the consequences of limited bandwidth and nonlinear interaction effects on the pulse response. In the beam-plasma area, the strong interaction between an electron beam and a plasma is being studied. In the laser-induced emission area, two different gun and drift-tube structures have been designed and are nearly assembled for investigation of electron-beam formation, using laser-induced electron emission. One of these structures is designed for the direct-emission gun, whereas the other is suited for the indirect-emission gun. Author

N64-24787* National Aeronautics and Space Administration, Washington, D.C.
AN "ABSOLUTELY BLACK BODY" FOR THE CALIBRATION OF ACTINOMETRIC INSTRUMENTS
N. N. Gorokhovskaya and E. L. Podol'skaya *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 1–14 refs (See N64-24786 17-21) OTS: $2.75

To calibrate balance indicators and pyrgeometers, it is necessary to have a standard source of infrared radiation—an absolutely black body. The calibration of these actinometric instruments is discussed. G.D.B.

N64-24831* Midwest Research Inst., Kansas City, Mo.
EXTREME VACUUM TECHNOLOGY (BELOW 10^{-13} TORR) AND ASSOCIATED CLEAN SURFACE STUDIES
Paul J. Bryant, Charles M. Gosselin, and Lyle H. Taylor Washington, NASA, Jul. 1964 75 p refs
(Contract NASr-63(06))
(NASA-CR-84) OTS: $2.00

Experimental results are discussed in the following areas: (1) development of extreme vacuum technology using the vapor-jet mechanism and a helium permeation guard technique; (2) determination of the quantities and species of gas above gettering-ion pumps and chemically trapped oil diffusion pumps; (3) derivation of a physical adsorption isotherm for inert gases; (4) development of a total-pressure gage for readings below 10^{-12} torr; and (5) investigation of the adhesion or cold-welding tendency of metals exposed to vacuum and thermal outgassing. M.P.G.

N64-24836* National Aeronautics and Space Administration, Washington, D.C.
NUCLEAR PROCESSES IN CHROMOSPHERIC FLARES [YADERNYYE PROTSESSY V KROMOSFERNYKH VSPYSHKAKH]
B. M. Vladimirskiy and A. B. Severnyy Jul. 1964 11 p refs Transl. into ENGLISH from Izv. Krymsk. Astrofiz. Observ. (Moscow), v. 29, 1963 p 80–85
(NASA-TT-F-214) OTS: $0.50

The output of thermonuclear reactions and nuclear fission of the oxygen group nuclei by protons in a flare is estimated. As a result of flare activity in the solar atmosphere, deuterium is consumed and Li, Be, and B accumulate. The effect of the carbon cycle on energy production and the output of γ-quanta are found to be negligible. Author

N64-24878 Aerospace Corp., El Segundo, Calif.
STRAIN-DISPLACEMENT RELATIONS IN LARGE DISPLACEMENT THEORY OF SHELLS
C. H. Tsao 15 May 1964 17 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-87; TDR-269(4230-30)-4; AD-601806)

Formulas given in Novozhilov's book, "Foundations of the Nonlinear Theory of Elasticity," are modified and improved. Sign conventions for the principal radii are clarified. The relationships given are for the general shell of any shape. These relationships can be readily transformed to obtain the formulas for special shells, such as spherical, conical, cylindrical, or toroidal shells, for flat plates, and for curved and straight beams. Author

N64-24893 Sandia Corp., Albuquerque, N. Mex. Technical Information Div.
NEUTRON EFFECTIVENESS IN PRODUCING PHOTOCONDUCTIVITY IN DIELECTRIC MATERIALS
F. N. Coppage, A. W. Snyder, and F. C. Peterson Jun. 1963 21 p refs Presented at the Summer Gen. Meeting, IEEE, Toronto, Jun. 1964
(SCR-670)

Measurements of photoconductivity in several organic dielectrics irradiated with neutrons and gamma rays reveal that neutrons, relative to gamma rays, are less effective, per unit absorbed-dose rate, in causing photoconduction. Photoconductivities of polystyrene, polyisobutylene, Mylar, H-film, reconstituted mica, cellulose acetate, and polycarbonate were measured during exposures in the Sandia Pulsed Reactor. The ratio ($\dot{n}/\dot{\gamma}$) of the neutron absorbed-dose rate ($\dot{n}$) to the gamma-ray absorbed-dose rate ($\dot{\gamma}$) was varied with preferential shielding to separate the components of photoconduction arising respectively from neutrons and gamma rays. The empirical equation,

$$\sigma = A_n \dot{n}^{\delta} + A_\gamma \dot{\gamma}^{\delta},$$

has been found to fit the data of the measur d photoconductivity (σ), where A_n, $A\gamma$, and δ are empirical constants characteristic of a dielectric material. The ratio, A_n/A_γ, is a measure of the effectiveness of neutrons, relative to gamma rays, in producing photoconduction, and for the materials studied $0.06 \leqslant (A_n/A\gamma) \leqslant 0.55$. Author

N64-24894 Telecomputing Corp., San Diego, Calif. Narmco Research and Development Div.
OPTIMUM FILAMENT DIAMETER Quarterly Progress Report, 20 Jan.–20 Apr. 1964
J. Jobaris 16 Apr. 1964 49 p refs
(Contract NObs-86347)
(QPR-7; AD-439655)

Seven cylinders, three unstiffened and four ring-stiffened, were fabricated and tested in biaxial hydrostatic compression. All cylinders were made from 5-mil-diam E-glass fibers and Union Carbide ERL 2256 epoxy resin. The pertinent data and test results are reported. Author

N64-24922 Brookhaven National Lab., Upton, N.Y.
EIGENVALUE SPACING DISTRIBUTIONS FOR COMPARISON WITH EXPERIMENTAL DATA
K. Fuchel, J. D. Garrison, and Lourdes R. Zavitsas May 1964 37 p
(BNL-863(T-346))

A series of computer programs are described that utilize the output eigenvalues of the random matrix diagonalization code to obtain eigenvalue spacing distributions and their moments. These distributions and moments have been used for comparison with nuclear-level spacing distributions obtained from neutron cross-section measurements, and also for providing corrections for the nuclear-level spacing distributions and moments for the weak levels that have been missed experimentally and for the extra levels that may be erroneously included. Author

N64-24943 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate
ACOUSTICAL RAY TRACING
Robert P. Lee Jun. 1964 22 p refs
(ERDA-137; AD-601626)

A mathematical model for acoustic ray tracing is derived, taking into account the effects of temperature, winds, and earth curvature. A calculation procedure is outlined. Author

N64-24945 IIT Research Inst., Chicago, Ill.
ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF THE ACOUSTIC ENVIRONMENT OF THE RTD SONIC FATIGUE MAIN TEST CHAMBER Technical Documentary Report, 6 Mar. 1963–15 Feb. 1964
Franklin G. Tyzzer and David F. Pernet Wright-Patterson AFB, Ohio. Flight Dynamics Lab., Apr. 1964 114 p refs
(Contract AF 33(657)-10927)
(FDL-TDR-64-26; AD-601611)

The extreme versatility of the RTD Sonic Fatigue Facility creates problems in analysis and control of attainable environments. Acoustic environments were analyzed using both theoretical and experimental modelling techniques, with regard to spatial distribution and correlation of sound pressures. A diffuse field study enabled predictions of sound fields to be made for many cases of source and test structure parameters. Progressive-wave operation of the facility for small groups of sources was analyzed, and some typical pressure field distributions were evaluated. The modifying effect on the progressive wave pressure fields, caused by locating test structures in the fields, was studied with respect to the size, location, and orientation of test structures, the operational frequency of the source system, and the relationship between the individual sources forming the overall system. Conditions were established for obtaining uniform, gradual, or rapid variations, and alternate maxima and minima in sound-pressure level on the exposed surfaces of structures. In addition, conditions were established for operation of the facility to produce on structures areas of phase coherence having both large and small extent as well as narrow elongated extent. Author

N64-24946 Los Alamos Scientific Lab., N. Mex.
BETA-GAMMA RADIOACTIVITY IN ENVIRONMENTAL AIR AT LOS ALAMOS, NEW MEXICO, FOR 1963
Jack W. Aeby and W. R. Kennedy 2 Jun. 1964 24 p refs
(Contract W-7405-ENG-36)
(LAMS-3071) OTS: $0.50

The report is a continuation of work reported, in the Los Alamos section, of "Radioactive Fallout Data Collected from Eleven Atomic Energy Installations for 1958." The beta activities were not identified. However, since the measurements were made in the same manner, the values are relative to one another. The monthly average "per day" graphs show, in general, higher trends the first half of this year than last, with a tapering off toward the end of the year. Author

N64-24958 Tokyo U. (Japan) Aeronautical Research Inst.
THE INFLUENCE OF THE DISTRIBUTION OF THE COMPOSITION ON THE LIGHT SCATTERING OF THE STYRENE-ACRYLONITRILE COPOLYMER
Hirotaro Kambe, Itaru Mita, and Yuko Shimura Mar. 1964 9 p refs
(Rept.-381)

The influence of the heterogeneity of the composition on the molecular weight of the styrene–acrylonitrile copolymer determined by light scattering is described. Light-scattering measurements were carried out on eight solvents: acetone, ethyl acetate, butanone, chloroform, dimethyl formamide, chlorobenzene, bromobenzene, and α-bromonaphthalene. An azeotropic copolymer gives a constant molecular weight independent of the refractive index of the solvent used. Commercial samples having the same mean composition as the azeotropic copolymer show apparent molecular weight varying with the solvent. The relation of the apparent molecular weight to the variation rate of the differential refractive index increment with the composition reveals the characteristic distribution of the composition of the copolymer. In Litac the acrylonitrile contant is richer for the side having the higher molecular weight. KR has a distribution in which the higher the molecular weight is, the richer the content of styrene. In the azeotropic copolymer the homogeneity of the composition was proved as generally expected. Commercial Tyril shows the same characteristics. Author

N64-24976 Argentina. Comision Nacional De Energia Atomica Buenos Aires
POSSIBLE EVIDENCE OF THE EXISTENCE OF A DIPROTON OF He^2 THAT OCCURS WITH THE REACTION He^3-(D,T)He^2 [EVIDENCIA ACERCA DE LA EXISTENCIA DEL DIPROTON O He^2 A TRAVES DE LA REACCION He^3(DT)-He^2]
O. M. Bilaniuk (Rochester U.) and R. J. Slobodrian (Lawrence Radiation Lab.) Nov. 1963 17 p refs Presented at the XLI Reunion de La Asoc. Fis. Arg., Buenos Aires, May 1963 In SPANISH; ENGLISH Summary *Its* Informe no. 96
(Partially Supported by AEC)

The possible existence with finite lifetime of the diproton or He^2 has been investigated, using the reaction He^3(d, t)He^2 through the use of the external deuteron beam of synchrocyclotron, impinging on the target at 27 Mev. The diproton lifetime was obtained from rhe resulting discrete spectra as $\approx 2 \times 10^{-22}$sec. The angular distribution of the long-lived product (triton) was measured between 8° and 51° in the center of mass system, and fitted with a PWBA pickup curve of $l = 0$ and $r_0 = 5.5$ fm. A reduced width value $\theta^2 = 0.08$ was obtained from the latter, consistent with the values of other pickup reactions. The experimental proof that the reaction proceeds via a two body process, not differing neither qualitatively nor quantitatively from other similar processes, as well as the measurement of the lifetime of the residual system of two protons, permits to state that the diproton does not differ substantially from other short-lived nuclei or nuclear states with lifetimes of the same order of magnitude. Author

N64-24996* Maryland U., College Park, Md. Inst. for Molecular Physics
QUANTUM EFFECTS IN SMALL-ANGLE MOLECULAR-BEAM SCATTERING
E. A. Mason, J. T. Vanderslice, and C. J. G. Raw Repr. from the J. of Chem. Phys., v. 40, no. 8, 15 Apr. 1964 p 2153–2164 refs
(Grant NsG-5-59)

Quantum-mechanical calculations of the differential cross section for the small-angle elastic scattering of heavy particles are carried out to establish more definitely the region of validity of the classical approximation. Four results are discussed: (1) The Massey-Mohr phase-shift formula corresponds to the Kennard small-angle scattering formula in the semiclassical limit. (2) The Schiff approximation for the cross section is exactly the same as the semiclassical approximation at small angles, for any central potential. (3) At very small angles the semiclassical limit for the differential cross section varies as exp $(-c\Theta^2)$, where c is a function of velocity for which explicit expressions are given. (4) The first quantum deviation from the classical limit, which is proportional to $\hbar^2$, can be combined with the preceding result to give a reasonable representation of the differential cross section over the entire range of small angles for which quantum deviations are appreciable. Detailed calculations for some specific systems are made, and it is shown that Wu's misgivings over the classical interpretation of the experimental results of Amdur and co-workers are unjustified. Author

N64-25019 General Dynamics/Fort Worth, Tex.
ANALYTICAL PREDICTION OF THE B-58A SPIN CHARACTERISTICS—PHASE II: CORRELATION OF ANALYTICAL MODEL SPIN PREDICTIONS WITH FREE FLIGHT MODEL TEST RESULTS
M. W. Bahnman, J. H. Brown, and B. G. Kouri 1 Sep. 1963 173 p refs
(Contract AF 33(600)-38975)
(FZE-4-059; AD-437686) OTS: $12.50

This spin investigation is composed of free-flight model spin-entry and developed-spin tests, static and rotary force-model wind-tunnel tests to extreme angles-of-attack and sideslip, and an analytical program for prediction of high angle-of-attack motion. The analytical predictions of vehicle motion are obtained using an IBM 7090 digital computer procedure developed specifically for this program. This digital procedure solves the six-degree-of-freedom equations of motion for a vehicle exhibiting complex nonlinear aerodynamic characteristics. Author

N64-25029 Cornell U., Ithaca, N.Y.
RADIATIVE PION-NUCLEON SCATTERING
P. Carruthers Nov. 1963 19 p refs
(Contract Nonr-401(51))
(AD-437662)

The cross section for bremsstrahlung in pion nuclear scattering is calculated from the results of the static nucleon theory. The result agrees well with a recent measurement of the reaction $\pi^+ + p \rightarrow \pi^+ + p + \gamma$ at an average pion laboratory kinetic energy of about 300 Mev. The theoretical result is 0.25 mb, compared to the experimental value 0.22± 0.05 mb. The energy distribution of the final pion is computed at laboratory energies of 200, 300, and 400 Mev. The 3-3 isobar shows up clearly at the latter two energies, in agreement with experiment. Experiments are suggested whereby the bremsstrahlung can be used as a probe to obtain information about the higher resonances in pion–nucleon scattering. Author

N64-25038 Stanford U., Calif. Microwave Lab.
A STUDY OF OPTICAL TRANSITION PROBABILITIES AND METHODS OF MODULATING THEM Semi-Annual Progress Report No. 3, 1 Apr.–30 Sep. 1963
A. L. Schanlow, W. Moos, W. M. Yen, and G. F. Imbusch Nov. 1963 5 p
(Contract DA-ARO(D)-31-124-G449)
(ML-1111; AD-437649)

An investigation was made of how the optical selection rules of ions in crystals can be modified by changing the crystal environment of the ion. In particular, an attempt was made to change the transition matrix element for the R-line transition in $MgO:Cr^{3+}$ from magnetic dipole to electric dipole. To achieve this, the crystal environment had to be modified in such a way as to introduce some crystal field of odd symmetry. R.T.K.

N64-25039 Centre National de La Rechercne Scientifique, Paris (France)
THE PERTURBATION OF SPECTRAL FREQUENCIES BY SOLID MATRICES Quarterly Technical Status Report, 1 Jul.–30 Sep. 1963
B. Vodar [1963] 3 p
(Contract DA-91-591-EUC-2882)
(QTSR-2; AD-437652)

Pure krypton and krypton in argon were obtained at liquid hydrogen temperature spectra. Although not yet microphotometered, two bands at 1,220 A and 1,145 A were observed in pure krypton, confirming the results of Baldini. The two bands are displaced toward shorter wavelengths to about 1,150 A and 1,090 A in a matrix of argon. Using cleaved lithium fluoride windows made such short wavelengths possible. G.D.B.

N64-25053* National Aeronautics and Space Administration. Lewis Research Center,. Cleveland, Ohio
AZIMUTHAL MAGNETIC FIELD OF A THICK, FINITE-LENGTH, HELICAL SOLENOID
Edmund E. Callaghan and James C. Stoll Washington, NASA, Jul. 1964 33 p refs
OTS: $1.00
(NASA-TN-D-2372)

The expression for the azimuthal component of the magnetic-field intensity of a thick, finite-length, helical solenoid is derived. An analytic solution is obtained in terms of complete elliptic integrals. Numerical results electronically computed for several combinations of coil thickness and length for a constant current density are presented in dimensionless form in a table and in sample graphs. Author

N64-25076 Emmanuel Coll., Boston, Mass. Research Language Center
AN EXTENSION OF THE "IDEAL OBSERVER" CRITERION [O PEWNYMUOGOLNIENIU KRYTERIUM "IDEALNOGO OBSERWATORA"]
J. Kulikowski Bedford, Mass, L. G. Hanscom Field, AFCRL Feb. 1964 11 p refs Transl. into ENGLISH from Arch. Electrotech. (Warsaw), v. 10, no. 3 1961 p 723–727
(Contract AF 19(628)-3869)
(E-T-P-64-3; AD-441573)

This article is concerned with a new type of the optimality criterion of binary statistical decisions that can be applied for undetermined properties of the statistical parameters of signal and distortion distribution. Author

N64-25088 Naval Research Lab., Washington, D.C. Metallurgy Div.
SYSTEMS AND TECHNIQUES FOR IN-REACTOR TEMPERATURE CONTROL OF NRL IRRADIATION EXPERIMENTS
J. R. Hawthorne and L. E. Steele Dec. 1963 19 p ref
(Contract AT(49-5)-2110)
(NRL-1486; AD-430750)

The irradiation of metallurgical test specimens in the beam port and fuel core facilities of various nuclear test reactors at temperatures ranging from 200° to 800° F necessitated the design and development of several temperature control systems. Basic systems employed for the irradiation of relatively massive loadings in the various experimental facilities are described in detail, and reference is made to inherent system advantages and limitations. Author

N64-25093 Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Research Center
DIFFUSION EXPERIMENT TO DETERMINE CERTAIN CROSS SECTIONS FOR COLLISIONS BETWEEN ELECTRONS AND GASES Final Report
B. T. Mc Clure 31 Mar. 1964 10 p refs
(Contract DA-31-124-ARO(D)-96; DA-11-022-ORD-4157)
(AROD-3331-5; AD-439582)

The interaction between low energy electrons and gases, He, Ne, Ar, H_2, and N_2 by a diffusion technique is studied. Investigated were the momentum transfer cross section and the cross section for inelastic, nonionizing collisions. All numerical results obtained from this study are listed. N.E.A.

N64-25103 Cambridge U. (Gt. Brit.)
DECAY OF ORBITS
P. J. Message *In* Am. Math. Soc. Lecture Notes Prepared in Connection with the Summer Seminar on Space Math., Pt. III 1963 p 435–454 refs (See N64-25102 17-29) OTS: $17.00 ph

The following are included: (1) expression for the drag force; (2) the effect of the tangential component; (3) the form of the atmosphere; (4) the King–Hele treatment of the secular changes (small orbital eccentricities); and (5) the effect on the apse, node, and inclination, including the nontangential components. R.T.K.

N64-25106 New York U., N.Y.
THE STABILITY BEHAVIOR OF THE SOLUTIONS OF HAMILTONIAN SYSTEMS
J. Moser *In* Am. Math. Soc. Lecture Notes Prepared in Connection with the Summer Seminar on Space Math., Pt. III 1963 p 551–593 refs (See N64-25102 17-29) OTS: $17.00 ph

Kolmogorov has found the existence of almost periodic solutions of Hamiltonian systems. The statement of Kolmogorov's results, in application to celestial mechanics, and an indication of its proof are discussed. R.T.K.

N64-25110 Battelle Memorial Inst., Columbus, Ohio
ATOMIC AND MOLECULAR REACTIONS DURING LAUNCH AND RE-ENTRY Final Report
R. H. Barnes, R. G. Jung, J. F. Kircher, R. L. Ritzman, J. C. Smith et al 31 Mar. 1964 110 p refs
(Contract SD-80; ARPA Order 197)
(BMI-197-10-2; AD-437206)

This is a report on a project to survey current knowledge of certain atomic and molecular reactions pertinent to ARPA problems and to point out those areas needing further study. The reactions of pure air at high temperature and of air components with simple hydrocarbon molecules were investigated from the standpoint of reentry chemistry. Some preliminary work with a computer program was done to study the effect of possible reactions involving ablation products on reentry chemistry. Some very preliminary results are reported. Certain ion reactions, in particular ion loss mechanisms in the atmosphere and the phenomenon of chemi-ionization, were investigated. Wherever possible the pertinent data were tabulated for quick reference, and some conclusions were drawn. Author

N64-25113 Utah U., Salt Lake City Microwave Devices Lab.
ELECTRON BEAM COMPRESSION WITH ELECTRIC AND MAGNETIC FIELDS
Kenneth I. Talbot and Curtis C. Johnson Jun. 1964 54 p refs
(Grants NSF G-15017; NSF GP-843)
(NSF-6)

This paper presents design and test information on a cylindrically focused beam with a current density of 2,500 amps/cm^2. The beam entrance conditions and the magnetic field intensity at the cathode are critical parameters in the gun design. Under proper conditions, the beam produced will be well focused with little ripple, but if these conditions are not properly met, the beam may become severely unstable. The case of zero magnetic field at the cathode was investigated for various entrance parameters. Theoretical and experimental data are presented that describe the effects of magnetic flux at the cathode and thermal velocities. Author

N64-25114 Queens U., Kingston (Canada)
A STUDY OF SOME IMPULSIVE NOISE MODELS
I. F. Blake Feb. 1964 66 p refs
(Contract DRB/313002/004/713-22-30-763)
(RR-64-1; AD-437227)

An investigation of impulsive noise, before and after linear filtering, is presented. The mathematical noise models treated include a Poisson, a periodic, and an extended Poisson process. The Charlier polynomials and the Jordan series, which is an expansion of a function of a discrete variable in a series of orthogonal polynomials, are discussed in some detail. An analytical technique using this series is introduced to find the characteristic function of the amplitude distribution of the filter output for the extended Poisson process. Experimental amplitude distribution curves for the filter output are obtained for a Poisson and a periodic process. Author

N64-25117 Los Alamos Scientific Lab., N. Mex.
CRITICAL DIMENSIONS OF SYSTEMS CONTAINING U^{235}, Pu^{239}, AND U^{233}
H. C. Paxton, J. T. Thomas, Dixon Callihan, and E. B. Johnson Tenn., Oak Ridge Natl. Lab., Jun. 1964 152 p refs
(TID-7028) OTS: $1.75

The critical dimensions for single-unit systems and multiple-unit arrays are presented. The single units are: (1) U^{235}-enriched uranium units, reflected and unreflected; (2) Pu units, reflected and unreflected; (3) U^{233} units, reflected and unreflected; (4) poisoned solutions; (5) fissile units with various reflectors; and (6) complex shapes (annuli and pipe intersections). Multiple-unit arrays consist of homogeneously moderated units and metal units. I.v.L.

N64-25126 Joint Publications Research Service, Washington, D.C.
RECOMBINATION RADIATION IN CADMIUM TELLURIDE DURING EXCITATION BY PULSES OF FAST ELECTRONS
V. S. Vavilov, E. L. Nolle, V. D. Yegorov, and S. I. Vintovkin 2 Jul. 1964 13 p refs Transl. into ENGLISH from Fiz. Tverd Tela (Moscow), v. 6, no. 5, May 1964 p 1406–1412
(JPRS-25344; TT-64-31617) OTS: $0.50

During excitation by fast neutrons, a recombination radiation originates in cadium telluride, the spectrum of which in the area of photon energies of 0.7 to 1.6 ev consists of three intensive bands with maximums at photon energies of 1.05 ±0.01, 1.47 ±0.01, and 1.59 ±0.01 ev for 10° K. The temperature dependence of the intensity and position of the bands of recombination radiation in the temperature interval of 10° to 300° K was investigated. The short-wave radiation band lies in the area of the edge of the main absorption band and has a temperature shift factor equal to $-(4.0\pm0.1),10^{-4}$ ev per degree. At 10° K the short-wave radiation band observes a structure in the form of steps, the origin of which, from the viewpoint of the authors, is explained by the radiation junctions, associated with the emission of longitudinal optical phonons with an energy of 0.020 ±0.002 ev. The nature of the recombination radiation spectrum, which spectrum originates in CdTe during excitation by fast electrons, and the possibility of intensifying the radiation are all discussed. Author

N64-25191 Aerojet-General Nucleonics, San Ramon, Calif.
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM Quarterly Progress Report, 1 Jan.–31 Mar. 1964
R. H. Chesworth 15 May 1964 99 p refs
(Contract AT(10-1)-880)
(IDO-28626) OTS: $2.25

The purpose of the program is to develop a mobile, low-power, nuclear powerplant capable of extended operation under military field conditions. Inspection of a tube removed from the seven-tube mock-up of the ML-1 calandria revealed no evidence of corrosion or other deleterious effects. The calculated hot spot temperature for the ML-1-I fuel elements was revised downward from 1,700° to 1,650° F by a reevaluation of hot spot factors, which included consideration of recent experimental data. Evaluation of the ML-1-II burnable poison was completed. The IB-17R-2 postirradiation examination was completed; no abnormal conditions were observed. Irradiation of the IB-17R-3 test element continued without incident. Author

N64-25213 Naval Radiological Defense Lab., San Francisco, Calif.
A SEMI-EMPIRICAL STUDY OF THE SHELL MODEL PROTON-NEUTRON INTERACTION
J. M. Ferguson 18 Feb. 1964 31 p refs
(USNRDL-TR-723; AD-600695)

In the independent-particle model of the nucleus, all the nucleon–nucleon interactions are represented by a simple potential well. Each nucleon is assumed to move freely in the well, independent of the other nucleons. In the first-order correction to this model, an effective interaction is introduced between the last few nucleons in the nucleus. The interaction produces a small correction to the nucleon binding energies. The problem in this paper was to investigate the consequences of using a very simple form for this interaction, comparing the results with experimental binding energies to see how well it worked. For odd-odd nuclides (odd number of protons and odd number of neutrons) with two particles outside closed configurations, the simple interaction agreed with the experimental data with about 30% probable error. Because the agreement is due partly to the fitting of two arbitrary parameters, the probable error in predicting new binding energies is somewhat larger—perhaps a factor of two. In view of the many simplifications in the model, the agreement between theory and experiment is surprisingly good. Author

N64-25217 Army Missile Command, Huntsville, Ala.
THE (n,2n) REACTION ON DEUTERIUM
Dale R. Koehler 22 Apr. 1964 46 p refs
(RR-TR-64-4; AD-601793)

The D(n,p)2n reaction is treated in a direct interaction framework wherein the phenomenological nucleon–nucleon potentials of Gammel and Thaler are used to describe the perturbation interactions. Tensor forces as well as central forces are included, and final-state interactions among the particles are considered. The final state is pictured as a continuum deuteron plus free neutron or as a continuum dineutron plus free proton. To the extent that this picture is accurate, the main contributions to the cross section are supplied by the doublet-to-doublet transitions. The calculations furthermore suggest a best choice for the triplet even parity central potential. A comparison with the experimental results of Ilakovac et al at 14.4 Mev is presented. Author

N64-25293 Oak Ridge National Lab., Tenn.
THERMONUCLEAR DIVISION SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING APRIL 30, 1964
A. H. Snell et al Jul. 1964 172 p refs
(Contract W-7405-ENG-26)
(ORNL-3652) OTS: $2.75

The current program status includes the following: (1) Investigations of plasmas established by Lorentz-force trapping at very low pressures continue to indicate that the measured charge-exchange loss is less than the proton input current. (2) "Burnout", or complete ionization of a plasma, has apparently been accomplished by means of intense heating via electron-beam–plasma interaction. (3) Extensive studies of moving striations in the rare gases in gas discharge tubes indicate that the striation velocity corresponds to the ionic sound wave velocity as modified by ion–neutral collisions. (4) Pressures of less than 10^{-10} torr have been obtained with the cross-beam cross-section apparatus. (5) Variations in the design of the duoplasmatron ion source have resulted in hydrogen ion beams that are larger (500 ma) and less divergent. (6) The theoretical thermodynamic upper bounds of anomalous plasma diffusion across magnetic fields were found to agree with experiments. (7) Calculations were made that can be directly applied to the design of magnetic coils. These calculations show how much field strength must be sacrificed in order to achieve a desired field homogeneity. Also, the results of work on the chemical reactions and physical behavior of organic compounds in vacuum systems are described. I.v.L.

N64-25315 Georgetown U., Washington, D.C.
VIRTUAL ORBITAL METHOD
William L. Clinton [1964] 6 p
(Contract DA-31-124-ARO(D)-14)
(QSR-6; AD-439589)

The current program status includes the following: (1) Work on the virtual orbital method has continued in an attempt to arrive at $\underline{R_U}$ or $\underline{R_O}$. At the present time, the method of deoccupying the full $\underline{S}^{-1}$ density matrix for each symmetry class is essentially semiemperical. That is, on the basis of the qualitative shapes of the energy curves obtained, it was evident that a simple fractional deoccupation of the various symmetry blocks may generate a reasonable representation of the energy curve. (2) Force constants and frequencies have been calculated for the first row of the periodic table using Slater, best Slater, and Hartree–Fock atomic densities. The average percent in the calculated force constants are: 21.9% (Slater), 22.0% (best Slater), and 18.3% (Hartree–Fock). Molecular scaling of the Hartree–Fock atomic densities resulted in the best overall agreement with experiment—average error in force constants is 14.1%. An interesting empirical correlation

exists between the average of the molecular-charge-weighted atomic densities evaluated at the equilibrium distance and the observed force constants. I.v.L.

N64-25319 Columbia U., New York, N.Y. Columbia Radiation Lab.

RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM Fifth Quarterly Progress Report, 16 Dec. 1963–15 Mar. 1964

R. Novick 15 Mar. 1964 65 p refs
(Contract DA-36-039-SC-90789)
(CU-3-64-SC-90789; AD-439695)

Further studies were made of the two-photon decay of the metastable helium ion. Precise values have been obtained for the hyperfine interaction constants in the $(3d^5 4p)^7P_{2,4}$ states of Cr^{53}. Polarization and excitation studies are continuing on the $(1s\ 2p)^3P - (1s\ 2s)^3S$ transition in LiII preliminary to the determination of the ^3P fine structure. Improved detectors are being developed for the study of metastable autoionizing atomic states. Work is being resumed on the determination of the fine and hyperfine structure of the 3P term of LiI. Light sources and resonance cells are being developed for double-resonance spectroscopy in the radioactive isotopes of lead and copper. Precise measurements have been made of the hyperfine structure of the $3_{13} - 3_{03}$ rotational transition in NH_2D. A new program of molecular magnetic rotation spectroscopy was undertaken for the analysis of the vibrational structure of selected molecules. Work was resumed on the experiment designed to determine the interaction between free atoms and crystalline surfaces. A detailed ENDOR study of the V_K center in LiF has been completed. A discussion and interpretation are given of the angular dependence of the ENDOR lines arising from this center. The optical-maser-homodyne spectrometer is being applied to problems in critical opalescence, fluid flow, and birefringence. A HgII green laser is being constructed for use on these experiments. Studies are being made of the fluorescence of a ruby crystal following excitation by ruby-laser light. The results of these studies will be useful in determining the feasibility of the proposed photon-echo experiment. Author

N64-25345 Utah U., Salt Lake City

ENERGY PARTITIONING IN HIGH-VELOCITY-IMPACT CRATERING IN LEAD, PART I. INTERNAL ENERGY AND DEFORMATION IN ROD-TO-ROD IMPACT, PART II. RESPONSE OF A THERMOCOUPLE JUNCTION TO SHOCK WAVES IN COPPER, PART III

Gerry H. Turner, E. Paul Palmer, David W. Pratt, and Harlan W. Christmas May 1964 141 p refs
(Contract AF 04(694)-259)
(UU-14; BSD-TDR-64-95; AD-602281)

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Part 1: ENERGY PARTITIONING IN HIGH-VELOCITY-IMPACT CRATERING IN LEAD G. H. Turner and E. P. Palmer 90 p refs (See N64-25346 17-23)

Part 2: INTERNAL ENERGY AND DEFORMATION IN ROD-TO-ROD IMPACT E. P. Palmer and D. W. Pratt 32 p refs (See N64-25347 17-23)

Part 3: RESPONSE OF A THERMOCOUPLE JUNCTION TO SHOCK WAVES IN COPPER E. P. Palmer, G. H. Turner, and H. W. Christmas 7 p refs (See N64-25348 17-23)

N64-25346 Utah U., Salt Lake City

ENERGY PARTITIONING IN HIGH-VELOCITY-IMPACT CRATERING IN LEAD. PART I

Gerry H. Turner and E. Paul Palmer *In its* Energy Partitioning in High-Velocity-Impact Cratering in Lead, Pt. I. Internal Energy and Deformation in Rod-to-Rod Impact, Pt. II. Response of a Thermocouple Junction to Shock Waves in Copper, Pt. III, May 1964 90 p refs (See N64-25345 17-23)

Original methods are presented for determining how the kinetic energy of a projectile is partitioned among various competing processes occurring in high-velocity-impact cratering in lead targets. Three main processes are considered—target heating, ejection of material (spray particles) from the crater, and recrystallization of target material. In measuring target-heating energy, the target is considered as a calorimeter and a thermocouple is used to measure its temperature change. The energy involved in the heating action is then calculated from this change. A relationship between spray-particle mass and energy is given, showing that at all projectile impact velocities, spray particles leave the crater with an energy (the sum of their kinetic and thermal energies) of about 114 joules per gram. Displacement and deformation of target material are discussed. A simple model is presented to relate displacement and deformation of target material in terms of its final grain size and its original and final positions in the target. Author

N64-25347 Utah U., Salt Lake City

INTERNAL ENERGY AND DEFORMATION IN ROD-TO-ROD IMPACT Part II

E. Paul Palmer and David W. Pratt *In its* Energy Partitioning in High-Velocity-Impact Cratering in Lead, Pt. 1. Internal Energy and Deformation in Rod-to-Rod Impact, Pt. II. Response of a Thermocouple Junction to Shock Waves in Copper, Pt. III, May 1964 32 p refs (See N64-25345 17-23)

If two identical, short cylindrical rods collide end-on, the amount of energy going into internal energy can be computed from measured velocities before and after collision. An experimental program was conducted to measure internal energy for the collision of rods of copper, lead, and steel. Velocities of 83 to 1,164 fps were used with copper, 77 to 421 fps for lead, and 80 to 1,350 fps for steel. Internal energy was successfully measured and related to deformation. Some shots were made at velocities up to 3,800 fps with copper to observe deformation. The collisions are almost completely inelastic for velocities of 260 fps for copper, 130 fps for lead, and 390 fps for steel. The results indicate the magnitude of the energy that is absorbed in deformation and the impact and material velocities associated with this energy absorption. Author

N64-25348 Utah U., Salt Lake City

RESPONSE OF A THERMOCOUPLE JUNCTION TO SHOCK WAVES IN COPPER—Part III

E. Paul Palmer, Gerry H. Turner, and Harlan Christmas *In its* Energy Partitioning in High-Velocity-Impact Cratering in Lead, Pt. I Internal Energy and Deformation in Rod-to-Rod Impact, Pt. II Response of A Thermocouple Junction to Shock Waves in Copper, Pt. III, May 1964 7 p refs (See N64-25345 17-23)

In the course of experiments to measure temperatures in the vicinity of craters produced by high velocity impact, thermocouples were attached to the surfaces of metal targets and embedded in them. In many cases, a small jump in output voltage occurred at the time of impact. These thermocouple voltage measurements were made with a microvolt meter having a response time of 1/2 sec. To produce waves strong enough to be easily measured, a thin copper target was used with wire silver-soldered to the rear surface to form a thermocouple. The use of a thermocouple junction for measuring wave strength

has wide possibilities for application in any solid, liquid, or gas system where strong waves are present. The initial results do not give conclusive evidence as to what is being measured, and any system used as a transducer requires calibration with known waves. G.D.B.

N64-25357 California U., Livermore Lawrence Radiation Lab.
THE SCATTERING OF PROTONS BY O^{18}
Jack Stevens (Ph.D. Thesis) 20 Mar. 1964 122 p refs
(Contract W-7405-ENG-48)
(UCRL-7648) OTS: $2.25

The scattering of protons by O^{18} in the energy range of 7.89 to 16.28 Mev was studied; 11 angular distributions were obtained for elastically scattered protons, for protons leaving O^{18} in its first excited state, and for alpha particles from the reaction $O^{18}(p,\alpha)N^{15}$. In addition, excitation functions were obtained at five angles; these angles included the zeros of the first four Legendre polynomials. A strong resonance is exhibited in both the elastic and inelastic scattering at about 10.5 Mev. Calculations made with an optical model using a Saxon–Woods real potential and a gaussian imaginary potential plus a spin-orbit term compare very well with experiment; however, the parameters obtained are not a smooth function of the energy. Distorted-wave Born approximation calculations of the inelastic scattering compare reasonably with the experiment and lead to an estimate of the nuclear deformation β. Author

N64-25362 California U., Livermore Lawrence Radiation Lab.
HAZARDS CONTROL Quarterly Report No. 16, Jan–Mar. 1964
D. E. Jones et al [1964] 49 p refs
(Contract W-7405-ENG-48)
(UCRL-7811) OTS: $1.25

The current status of the various research areas is as follows: (1) Preliminary data are given concerning the dosimetric sensitivity, energy dependence, and reproducibility of pure LiF doped with europium and magnesium. (2) New luminescent dosimeter materials were developed that have more favorable energy-dependence characteristics than strontium sulfide. (3) A simple model for estimating eye damage is discussed, and tentative "safe" levels of 10^{-7} joule and 10^{-6} watt for pulsed and continuous lasers, respectively, are given for laser radiation entering the eye. (4) A portable battery-operated Hi-Volume air sampler, which operates 30 minutes before recharging, is necessary. (5) Radioiodine sampling tube losses depend more on transport velocity than on the tube material. (6) A new system for the ventilation of soldering and acid dip tank operations has been successfully applied. (7) A method is described for decontaminating surfaces of contaminated platinum metal. (8) Laboratory tests of five commercial brands of surgeon-type gloves indicate that quality is not commensurate with cost. I.v.L.

N64-25369 Gesellschaft für Kernenergieverwertung in Schiffbau und Schiffart MBH., Hamburg (W. Germany)
ANNUAL REPORT ABOUT SHIELDING EXPERIMENTS AT THE GEESTHACHT REACTOR STATION DURING 1962 [ABSCHIRMUNGSEXPERIMENTE AM FORSCHUNSREAKTOR GEESTHACHT JAHRESBERICHT 1962]
D. Bünemann et al Brussels, EURATOM, Mar. 1964 317 p refs In GERMAN; ENGLISH summary
(Contract EURATOM-002-61-10 PNID)
(EUR-534.D Pt. II) Available from the Belgian Am. Bank and Trust Co., N.Y. Account No. 121.86: 400 Belg. Fr.

The experimental setup is described for collimated-beam radiation-shielding experiments, which were conducted to obtain a catalog of results for various material combinations relative to the optimization of planned shielding designs. Experimental methods and results of radiation-field measurements in pure water and on various shielding designs are given. Shielding experiments conducted on large plates are also described. Laminated structures, which correspond to the radial portions of the planned power reactors, were constructed from 2×2.5 m^2 plates of various materials. Measurement techniques, as well as the results of measurements in pure water and on various shielding designs, are given. The development of semiconductor detectors for fast-neutron spectrometry and of pulsating-stress detectors is discussed. Various theoretical works on the calculation of neutron flux and gamma radiation in laminated structures are summarized. I.v.L.

N64-25371 Oklahoma U. Research Inst., Norman
HIGH PRESSURE PHYSICS LABORATORY Final Report
Stanley E. Babb, Jr. May 1964 102 p refs
(Contract Nonr-982(05))
(AD-600902)

Accomplishments of this project include the following: (1) the development of techniques for measuring melting curves of metals to an accuracy hitherto unrealized; (2) the demonstration that the manganin wire pressure gage is nonlinear to 10,000 bars; (3) the provision of rough values for the corrections to be applied to the EMF of chromel–alumel thermocouples as a function of pressure and temperature to 10,000 bars and 400° C; (4) the evalution of Simon constants for most of the substances that have had their melting curves run; (5) the construction of a simple high-pressure valve, improved pressure seals, and a plug with a high current lead capable of introducing 50 amp into a 10,000-bar chamber, and the development of a good internal furnace design; (6) measurements of the melting curves of a number of substances gaseous under normal conditions, and the demonstration that propane and propylene have great promise for pressure transmitting fluids in the very high pressure range; (7) the determination of a maximum melting temperature in KNO_3 and the measurement of the melting curve of this compound over an extended range; (8) the discovery of new forms of $SbCl_3$ and $SbBr_3$; (9) the demonstration that all current theories of the melting curve are inadequate; and (10) the completion of a study of the thermostating action of metal block thermostats. I.v.L.

N64-25372 White Sands Missile Range, N. Mex.
GRAVITATIONAL SMOOTHING
Robert E. Green Feb. 1964 14 p refs
(TM-0930-2; AD-437999)

A method of using the acceleration due to gravity to improve range and range rate measurements by the method of least squares is presented. A method of determining radial acceleration from the calculation of gravitational acceleration is included. Some of the limitations of the gravitational smoothing technique are enumerated. Author

N64-25380 Flight Sciences Lab., Inc., Buffalo, N.Y.
A GENERAL INVESTIGATION OF HYPERSONIC STABILITY AND CONTROL UNDER TRIMMED FLIGHT CONDITIONS Second Quarterly Technical Report
24 Jun. 1964 83 p refs
(Contract NOw-64-0201-c)
(R-63-011-109; AD-442960)

Analytic equations were determined for the force and moment coefficients and stability derivatives of various shapes in Newtonian flow. Equations for all the important damping derivatives of the cone at zero sideslip and roll were determined as a function of angle-of-attack. The constants in these simple equations can be determined numerically for any C.G. location and any cone angle. For slender cones, with certain restrictions on the C.G. location, the constants in the stability derivative equations have also been determined analytically. Similar results were obtained for the delta planform with diamond-shaped cross section perpendicualr to the longitudinal axis. A preliminary investigation has also been conducted on the elliptic cone, and equations were established for the longitudinal force coefficients. A preliminary investigation was made of the effects of bluntness on the constants in the stability equations. These results were applied to the determination of analytic equations for the longitudinal force coefficients of the blunt cone. An initial investigation was undertaken into other hypersonic theories, besides Newtonian, for predicting surface pressures. Based on preliminary results, a method was outlined for determining the variations of the hypersonic stability derivatives with Mach number. Author

N64-25381 RAND Corp., Santa Monica, Calif.
POTENTIAL ENERGY CURVES FOR N_2, NO, O_2, AND CORRESPONDING IONS
F. R. Gilmore Jun. 1964 46 p refs
(Contract AF 49(638)-700)
(RM-4034-PR; AD-601598)

Potential energy curves for the observed electronic states of N_2, N_2^+, NO, NO^+, O_2 and O^+ were calculated from published spectroscopic data by a numerical modification of the Rydberg–Klein method. Potential energy curves for a number of predicted but unobserved states of these molecules, and of the ground states of N_2^- (unstable), NO– and O_2^-, have been estimated with the help of simple theoretical considerations, published quantum-mechanical calculations, and indirect experimental evidence. The results are presented graphically. Author

N64-25395 Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
NONLINEAR OSCILLATION AND NEUROELECTRIC PHENOMENA I
Edmond M. Dewan Jun. 1963 48 p refs
(AFCRL-63-149(1); AD-411851)

This is the first of a series of papers that treat both normal and epileptic electroencephalographic phenomena from a new point of view. Phenomena such as spontaneity of normal discharges, epileptic involvement of normal neurons, epileptic hypersynchrony, exhaustion, and normal and epileptic excitation and suppression effects are compared to phenomena of nonlinear oscillations, such as soft-limit cycle behavior, hard-limit cycle behavior, nonlinear entrainment effects, oscillation hysteresis and Van der Pol oscillations, and asynchronous excitation and quenching effects, respectively. The first two phenomena are examined in this paper, as well as soft- and hard-limit cycle behavior. The goal of this work is to lead toward a mathematical phenomenological scheme that shows relationships between seemingly diverse neuroelectric activity and to suggest new experiments that will increase man's understanding of the brain mechanisms responsible for normal and abnormal activity. Author

N64-25405 Air Force Cambridge Research Labs., Bedford, Mass. Office of Aerospace Research
REPORT ON RESEARCH AT AFCRL JULY 1962–JULY 1963. SURVEY OF PROGRAMS AND PROGRESS IN FY-1963
Feb. 1964 66 p refs
(AFCRL-64-25; AD-602165)

Recent achievements, progress, and results obtained in the following facilities are discussed: (1) the space physics laboratory—radioastronomy, the Sacramento Peak Observatory, astrophysics, lunar and planetary research, the earth's magnetic field, the near-earth environment, and energetics research; (2) the solid-state sciences laboratory—the ultrapurification of materials, analytical chemistry, radiation effects, crystal growth, device research, lattice dynamics, and the physical properties of crystals; (3) the meteorology laboratory—atmospheric circulations, satellite meteorology, cloud physics, and weather radar; (4) the microwave physics laboratory—antenna research, theoretical studies, microwave phonons, the plasma sheath, and wave propagation experiments; (5) the upper atmosphere physics laboratory—structure and general properties, the ionosphere, wave propagation, and ultraviolet radiation; and (6) the aerospace instrumentation laboratory—research probe program, balloon technology, and the aerospace environment. I.v.L.

N64-25442 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
SMALL DENOMINATORS AND PROBLEMS OF STABILITY OF MOTION IN CLASSICAL AND Celestial Mechanics
V. I. Arnol'D 25 May 1964 142 p refs Transl. into ENGLISH from Uspekhi, Mat. Nauk (Moscow), v. 18. Nov. 6, 91–192
(FTD-MT-64-175; AD-601963

In this report full proofs of the following are expounded: (1) the stability of positions of equilibrium and of periodic solutions of conservative systems with two degrees-of-freedom in the so-called general elliptic case; (2) the perpetual adiabatic invariance of the action variable during slow periodic variation of the parameters of a nonlinear oscillatory system with one-degree-of-freedom (it has been established that a "magnetic trap" with an axially symmetric magnetic field is perpetually able to retain charged particles); and (3) the finding of conditionally periodic motions in the many-body problem. If the masses of N "planets" are sufficiently small compared with the mass of the central body, then motion is conditionally periodic for the majority of initial conditions for which eccentricities and inclinations of Kepler ellipses are small. I.v.L.

N64-25450 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
APPROXIMATE ESTIMATION OF THE FORMING ENERGY OF THIN-WALLED COMPONENTS
M. A. Anuchin, L. P. Orlenko et al 12 May 1964 16 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedeniy, Mashinostro. (Moscow), no. 12, 1962 p 158–167
(FTD-TT-64-249/1+2+4; AD-601760)

This article contains an approximate method for calculating the forming energy of thin-walled, axisymmetric components. The calculations made by the proposed method were verified experimentally on a special apparatus for hydraulic stamping. The forming energy for a component is the sum of the energies, including deformation energy fron tension-compression stress, bending energy, and friction. The bending energy for thin-walled components is small, and together with the forming energy, accounts for about 20% of the total energy. G.D.B.

N64-25457 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ULTRAVIOLET FLUORESCENCE MICROSCOPY
Ye. M. Brumberg 28 Apr. 1964 25 p refs Transl. into ENGLISH from Zh. Obshch. Biol. (Moscow), v. 17, no. 6, 1956

p 401–412
(FTD-TT-63-1178/1+2+4; AD-600777)

Until recently, with rare exceptions, only the visible and longwave ultraviolet light with wavelengths greater than 350 mμ were used in fluorescence microscopy to excite fluorescence of preparations. The use of shortwave ultraviolet light is of great interest in solving many problems of biology. Some characteristics and qualities of this means of exciting fluorescence under fluorescence microscopy were examined. Most significant is the possibility of studying ultraviolet fluorescence of micro-objects. Author

N64-25463 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROPAGATION VELOCITY OF ULTRASONIC WAVES IN SOLIDS
N. F. Otpushchennikov 28 Apr. 1964 5 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 25, no. 1, 1953 p 127–128
(FTD-TT-64-120/1+4; AD-600813)

Results of measurements of the propagation velocity of ultrasound in two metals and six dielectrics are tabulated. The two metals were iron and cast iron. The dielectrics were white marble, white porcelain, flint glass, polystyrene, rosin, and oak (against the grain). The wedge method was employed for measuring. In oak, owing to the comparatively large absorption of ultrasound, the measurement error reached ±160 m/sec. In the remaining solids, the accuracy was within ±40 m/sec. I.v.L.

N64-25490 Emmanuel Coll., Boston, Mass Research Language Center
THE PROPAGATION OF ELASTIC WAVES IN PLANE DISCS WITH A CIRCULAR HOLE [ZUR AUSBREITUNG DER STOSSWELLEN IN KREISLOCHSCHEIBEN
Alexander Kromm Bedford, Mass., AFCRL, Oct. 1963 20 p refs Transl. into ENGLISH from Z. Angew. Math. Mech., v. 28, no. 10, 1948 p 297–303
(Contract AF 19(604)-8505)
(E-T-G-63-31; AD-440906)

In a previous paper, a special case was treated in connection with the solution of propagation velocity problems, since elastic waves are caused by a sudden rotary-symmetric disturbance at the edge of the hole. The figures were left out through an oversight, and they are presented in this paper. Moreover, an additional special stress case mentioned briefly in the summary of the first paper is investigated in which the conditions, $t = 0$ at a constant radial velocity, is forced on the edge. I.v.L.

N64-25498 Naval Research Lab., Washington, D.C.
SYSTEMATIC ERRORS IN ULTRASONIC PROPAGATION PARAMETER MEASUREMENTS. PART I: EFFECT OF FREE-FIELD DIFFRACTION
V. A. Del Grosso 29 Jan. 1964 81 p refs
(NRL-6026; AD-437995)

Appreciable errors in sound speed and sound absorption determinations may be attributed to a neglect in applying appropriate corrections to situations closely approximating free-field conditions. The errors are shown to be more severe for the lower frequencies and shorter paths. For long paths the errors are generally such as to indicate an excessive loss in absorption measurements. This report contains, principally, graphs and tables of relative pressure and phase measurements as a function of the distance perpendicular to the transducer element. These data have been compiled for various transducer-crystal radii and for various wavelengths of operation. The tables, especially, are set up to permit accurate reading of diffraction corrections, particularly for absorption measurements in relatively low loss liquids or for sound speed measurements over relatively short paths or path differences. Author

N64-25499 Institute for Defense Analyses, Washington, D.C. Jason Div.
MULTIPLE SCATTERING IN THE DIFFUSION APPROXIMATION Research Paper P-65
E. E. Salpeter and S. B. Treiman Jul. 1963 30 p
(Contract ARPA SD-50)
(IDA/HQ-63-2209; AD-438721)

The passage of classical particles through a grainy scattering medium can be described by a linearized Boltzmann equation. A discussion is given of the physical conditions that justify the use of the Fokker–Planck diffusion approximation to this equation. Some limiting properties of the solutions of the diffusion equation are first discussed for the initial value problem in an infinite medium characterized by a diffusion length, D. For a total path length, $L << D$, convenient formulas are given for the distribution of scattering angles, θ, and for given Θ the first few moments of the final position vector are computed. These results are taken as a basis for approximate treatment of steady-state boundary value problems. The case of a particle beam incident on a thin plane parallel slab of thickness $d << D$ is considered. Approximate formulas are given for the angular distribution of the transmitted beam and for the (very small) fraction of the beam that emerges from the entrance face. Author

N64-25502 Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.
DETERMINATION OF MOMENTUM TRANSFER AND INELASTIC COLLISION CROSS SECTIONS FOR ELECTRONS IN NITROGEN USING TRANSPORT COEFFICIENTS
A. G. Engelhardt, A. V. Phelps, and C. G. Risk 23 Mar. 1964 54 p refs
(Partially sponsored by AF)
(TDS-64-928-113-P4; AD-602505)

Momentum transfer and inelastic collision cross sections for electrons in N_2 have been obtained from electron transport coefficients for values of the electron energy between about 0.003 and 30 ev. The recently proposed polarization correction to the rotational excitation cross sections of Gerjuoy and Stein leads to less satisfactory agreement between theory and experiment than do the unmodified cross sections. The cross sections for vibrational excitation are consistent with those of Schulz provided the sum total cross section is normalized to 5.5×10^{-16} cm^2 at 2.2 ev. Furthermore, a tail extending down to the threshold of 0.29 ev is postulated for the $v = 1$ vibrational level. Electronic excitation is approximated by a set of six effective cross sections that, for the most part, are consistent with previous results. Author

N64-25509 Carnegie Inst. of Tech., Pittsburgh, Pa.
LOW-TEMPERATURE MAGNETIC SUSCEPTIBILITIES OF THE HYDRATED NICKEL NITRATES
L. Berger and S. S. Friedberg 15 Mar. 1964 34 p refs Submitted for Publication
(Contract Nonr-700(05))
(TR-19; AD-439406)

The zero-field magnetic susceptibilities of $Ni(nO_3)_22H_20$, $Ni(NO_3)_24H_2O$, and $Ni(NO_3)_26H_2O$ have been measured in the liquid hydrogen and liquid helium ranges. The dihydrate is obtained by evaporation of a solution at 105° C. Its powder susceptibility has a large, sharp peak at 4.20° K, where it reaches 0.74 cgs/mole, then drops down to 0.2 cgs/mole below

2° K. When measured along the a-axis, the susceptibility of monoclinic crystals of the dihydrate shows a similar peak. It reaches 1.5 cgs/mole, but drops to vanishing values at lower temperatures. The susceptibility in the bc plane reaches only 0.3 cgs/mole, and is nearly isotropic. It drops little below 4.20° K. A spin Hamiltonian with $S = 1$ and uniaxial one-ion anisotrophy gives results in fair agreement with the experimental data if the exchange interactions are described in the molecular field approximation. The best fit corresponds to $s = 2.25$, $D/k = -6.50°$ K, $n_1 = +0.32$ mole/cgs, $n_2 = -2.12$ mole/cgs, where n_1 and n_2 are, respectively, the antiferromagnetic and the ferromagnetic molecular field constants. Author

N64-25516 General Electric Co., Schenectady, N.Y. Research Lab.
ELECTRICAL CONDUCTABLE IN ORGANIC SOLIDS Quarterly Technical Report, 1 Jan.–31 Mar. 1964
Charles M. Huggins and Oliver H. Le Blanc, Jr. [1964] 3 p
(Contract DA-31-124-ARO(D)-175; ARPA Order 462)
(AROD-4642-1; AD-442773)

This experimental program is divided along three general lines: (1) the study of the transport of carriers injected into insulating solids by an electron gun; (2) a series of electrical measurements on a highly conducting ion radical salt of tetracyanoquinodimethan; and (3) the study of carrier transport in some amorphous systems. G.D.B.

N64-25522 European Organization for Nuclear Research, Geneva (Switzerland) Proton Synchrotron Machine Div.
A THEORETICAL AND EXPERIMENTAL COMPARISON OF PROTON AND DEUTERON ACCELERATION IN THE CERN LINEAR ACCELERATOR (CLA)
T. Sluyters 21 Apr. 1964 29 p refs
(CERN-64-22; PS/4350)

Deuteron acceleration in the CLA is possible if an RF cell length of $2\beta\lambda$ instead of $\beta\lambda$ is used for protons for which the machine was designed. A maximum deuteron trapping of 50% was measured for emittances of the preinjector smaller than 4.0 cm/mrad. A maximum deuteron beam intensity of 7 mA (10 /μs pulse length) was obtained at 23 Mev with an emittance of < 3.0 cm/mrad and an energy spread of less than 100 kev for 65% of the beam. Higher efficiency can be expected with an increased electrical field at the input end of the Linac and a stronger focusing system in the first cavity. The dose rate at the input end of the machine is less than 1 mrem/h using a deuteron source of 120 mA × 15 μs/s, and at the output end the dose rate is less than 20 mrem/h. Author

N64-25526 Oak Ridge National Lab., Tenn.
ELECTRONUCLEAR DIVISION ANNUAL PROGRESS REPORT, FOR PERIOD ENDING DECEMBER 31, 1963
Robert S. Livingston Jun. 1964 127 p refs
(Contract W-7405-ENG-26)
(ORNL-3630) OTS: $2.50

In heavy-ion nuclear physics studies, the nitrogen and oxygen beams of the 63-in. cyclotron and the tandem Van de Graaff were used in investigations of statistical fluctuations in cross sections, of excitation functions and angular distributions for nucleon-transfer reactions, and of the spin-cutoff parameter from compound nucleus reactions. Improvements in instrumentation and computational techniques for the nuclear physics studies with protons revealed finer details in nuclear structure, for example in ^{92}Nb, ^{89}Zr, and neighboring nuclei, and produced much new information concerning levels of ^{190}Ir. A description of nuclear shell-model calculations, the results of a consideration of the Σ^- interaction with ^4He, and a continuation of investigations of the reactions between complex nuclei are reported. Author

N64-25534 Los Alamos Scientific Lab., N. Mex.
SEMIANNUAL STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING APRIL 20, 1964
J. L. Tuck et al 28 May 1964 80 p refs
(Contract W-7405-ENG-36)
(LAMS-3085) OTS: $2.00

The research status of the following areas relating to the pulsed closed and pulsed open high β non-zero absolute minimum approach toward thermonuclear reactors, with emphasis on magnetic bottles having curvature which are flute stable in the Longmire–Rosenbluth sense with non-zero field minima is discussed: (1) the testing of rotational plasma acceleration as a means for the generation and heating of plasma in non-zero minimum β field configurations; (2) the Mark III stuffed cusp experiment; (3) high-density plasma focus; (4) the emission of cyclotron harmonics by A.P.I.G. discharge; (5) numerical computations that provide tools for diagraming properties of complex magnetic fields in a straightforward manner and that provide numerical means for gaining insight into the characteristics of the orbits of individual charged particles that move in an electromagnetic field; (6) Scylla IV; (7) the transverse injection experiment; (8) the hydromagnetic plasma gun experiment; (9) Zeus component-development; (10) low cost ignitron development; (11) the development of a 10-kv high-density, low-cost capacitor; (12) the mercury high-voltage switch; (13) arc drop; (14) the closed solution of general nonpower crowbar equations; (15) ignitrons of 50-kv; and (16) the calked cusp energy system. I.v.L.

N64-25546 Atomics International, Canoga Park, Calif.
OSCILLATION MEASUREMENTS IN THE SODIUM REACTOR EXPERIMENT
C. W. Griffin and R. W. Keaten 15 Jun. 1964 27 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-7264) OTS: $0.50

Measurement of the reactor transfer function with a pile oscillator has been used to determine the zero power and "at-power" characteristics of the second fuel loading of the sodium reactor experiment. At zero power the results yielded $\ell^*/\beta_{eff} = 0.075$ sec, in good agreement with results on the first fuel loading. Measurements at power were first performed while the core had a positive prompt temperature coefficient associated with fuel rod bowing. The transfer function below 0.1 cps exhibited an increase in gain and decrease in phase angle compared to zero power. In addition, a complicated resonance structure was observed from 0.1 to 0.5 cps. This was associated with sustained flux oscillations of the same frequency. The transfer function results lead, in part, to a mathematical model describing the cause of the positive coefficient. After the clusters were constrained to prevent fuel rod bowing, the transfer function clearly demonstrated the elimination of the positive coefficient and associated effects. Author

N64-25547 Oak Ridge National Lab., Tenn. Physics Div.
THE YIELD OF ELASTICALLY SCATTERED 17 TO 21 MeV NEUTRONS FROM THE REACTION $C^{12}(h,n)C^{12}$
Marvin Vernon Harlow, Jr. (Ph. D. Thesis—Tex. U.) Jun. 1964 144 p refs
(Contract W-7405-ENG-26)
(ORNL-3615)

These experiments are discussed in terms of experimental apparatus, such as the neutron detector and monitor; the experimental procedure for the determination of the energy of the neutrons emitted from the target and other experimental

phases; the differential cross-section experiment, which, among other considerations, defines symbols and coordinate systems; and the total cross-section experiment in terms of the derivation of the equation used. G.D.B.

N64-25549 Rochester U., N.Y.
NON-LEPTONIC DECAYS
Riazuddin, A. H. Zimmerman, and Fayyazuddin (Atomic Energy Centre (Pakistan)) 23 Mar. 1964 10 p Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-32)

Nonleptonic decays are discussed on the basis of the current picture. The s-wave amplitudes for the nonleptonic decays of hyperons can be well understood on this basis. In particular, the experimentally given decay rate for $K_1^0 \rightarrow \pi^+ + \pi^-$ can be quantitatively explained provided that the method of strangeness-changing leptonic processes (discussed in an earlier paper) is followed. Author

N64-25558 Argentina. Comision Nacional de Energia Atomica, Buenos Aires
RELATION BETWEEN THE EFFECTIVE SECTIONS FOR THE ISOMERIC PAIR Cs^{134m}, Cs^{134} FORMED IN THE NUCLEAR REACTION $Cs^{133}(d,p)Cs^{134}$ [RELACION ENTRE LAS SECCIONES EFICACES PARA EL PAR ISOMERICO Cs^{134m}, Cs^{134} FORMADO EN LA REACCION NUCLEAR $Cs^{133}(d,p)Cs^{134}$]
S. J. Nassiff, A. Mocoroa, and H. Vignau (La Plata U.) 1963 8 p refs Its informe no. 99 In SPANISH

The relations were experimentally determined between the effective sections σ_m/σ_g for the isomeric Cs^{134m}, Cs^{134} produced in the nuclear reaction $Cs^{133}(d,p)Cs^{134}$, as a function of the energy of deuterons. The results obtained are discussed superficially. Trans. by D.E.W.

N64-25560 Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.
LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY. VOLUME I: INTRODUCTION—SUMMARY AND EVALUATION—DESCRIPTION OF THE PLANT
Sidney Visner Jan. 1964 79 p
(Contract AT(11-1)-1317)
(CEND-200, Vol. 1)

This reactor is a sodium-cooled fast reactor, which operates at a 2,500 mw thermal power, generating 1,060 mw net electrical power with a net efficiency of 42.4%. The sodium outlet temperature from the reactor is 1,100° F, to produce steam at a temperature of 1,000° F. This report contains a summary of the reactor characteristics, an evaluation of the design, a discussion of the supporting research and development programs, and a description of the reactor including drawings. I.v.L.

N64-25561 Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.
LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY. VOLUME II: DESIGN ANALYSIS—INSTRUMENTATION, CONTROL, AND SAFETY—CORE DESIGN CHANGE TO OBTAIN A NEGATIVE SODIUM COEFFICIENT
Jan. 1964 265 p refs
(Contract AT(11-1)-1317)
(CEND-200, VOL. II)

This volume contains the results of the design analysis, a description of the instrumentation and control requirements, a discussion of reactor safety, and a description of the reactor design with a gap between the core and radial blanket. G.D.B.

N64-25562 Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY Final Report
K. B. Steck, comp. Jan. 1964 542 p refs
(Contract AT(30-1)-3251)
(WCAP-3251-1)

The fuel cycle cost of 0.28 mills/kwh is achieved with a breeding ratio of 1.57 and doubling time of 10.5 full power years. The safety of the reactor is assured by a negative doppler coefficient, a controlled expansion fuel assembly that provides a negative coefficient of reactivity, and the modular design that provides neutronics similar to a small reactor. The fuel is separated into multiple compartments to minimize the effect of fuel movement. The mixed carbide fuel is bonded by sodium to the clad, and is vented to the coolant. This design permits high heat fluxes with low fuel temperatures, release of fission gas pressure, and space for fuel swelling, and does not require the neutron-embrittled clad to accept large strain at the end of a 100,000 MWD/T fuel life. This modular design is a safe design for an economic large core, and provides the important advantage that it can be prototyped in either the EBR-2 or the Fermi reactors. Author

N64-25563 General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY (1000 MWe UO_2-PuO_2 FUELED PLANT), VOLUME I
M. J. Mc Nelly Jan. 1964 220 p refs
(Contract AT(04-3)-189)
(GEAP-4418, Vol. 1) OTS: $3.00

A design study has been completed for a 1,000-mwe sodium-cooled mixed uranium–plutonium oxide fueled fast reactor with a breeding ratio of 1.25 and sodium outlet temperature of 1,100° F. The doubling time is less than 15 years. A detailed description of a reference 1,000-mwe fast breeder reactor plant is presented, together with design specifications and the experimental bases for the design. Estimates of the operating characteristics and economic performance of the reference design are given. The computational methods employed in the study are detailed, and the major uncertainties and sources of error are appraised. Author

N64-25564 General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
LIQUID METAL FAST BREEDER REACTOR DESIGN STUDY (1000 MWe UO_2-PuO_2 FUELED PLANT), VOLUME II
M. J. Mc Nelly Jan. 1964 451 p refs
(Contract AT(04-3)-189)
(GEAP-4418, Vol. 2) OTS: $5.50

This report is a documentation of the various consideration and design techniques involved in the design of the reference 1000 mwe fast oxide breeder reactor. The process for selecting the basic parameters of the reference design (fuel composition, sodium volume, core height–diameter ratio, etc.) is detailed. Variants consistent with these major parameters are explored, and reference choices are justified. The significance and limitation on performance imposed by the basic parameter choices are clarified (e.g., the performance of reactors with harder neutron spectra, longer fuel lifetime, higher specific power, etc., are investigated). The development require-

ments for advanced design are discussed. Appendices pertaining to the following are presented: fuel pin thermal performance, structural materials property data, fuel pin clad stresses, fission gas release computation, control rod thermal design, sodium property data, plutonium inventory doubling time, design alternates for the use of BeO in fast reactor cores, fuel rupture, and coolant voiding, the expected corrosion rate of stainless steel in dynamic sodium, combined thermal and pressure stresses, the effect of axial void on fuel performance, neutron cross sections, and the effect of vented fuel on fission product cross section. I.v.L.

N64-25568* Stevens Inst. of Tech., Hoboken, N.J.
PRINCIPLES OF GENERAL COVARIANCE AND THE ROLE OF COORDINATES IN GENERAL RELATIVITY Semi-annual Report, 1 Jul.–31 Dec. 1963
James L. Anderson Jan. 1964 4 p
(Grant NsG-326)
(NASA-CR-56829; SIT-P120(1/64)) OTS: $1.10 ph

The role of coordinates and coordinate conditions in physics was investigated. Preliminary to a study of the role of coordinate conditions in the derivation of the equations of motion in general relativity, the gage conditions in electrodynamics and their bearing on the interactions of charged particles were examined. The relationship between a mathematical coordinate system and a physical frame of reference was also investigated. G.D.

N64-25592 General Electric Co., Schenectady, N.Y. General Electric Research Lab.
RESEARCH AND DEVELOPMENT TO INVESTIGATE THE MICROSTRUCTURE OF THE INTERNAL MAGNETIC FIELD IN FERRO-, FERRI-, AND ANTIFERROMAGNETIC SOLIDS Final Report, 1 Feb. 1963–31 Jan. 1964
D. S. Rodbell, T. W. Moore, P. E. Lawrence, and I. S. Jacobs
Wright-Patterson AFB, Ohio, AF Mater. Labs., Apr. 1964 34 p refs
(Contract AF 33(657)-8462)
(ML-TDR-64-58; AD-602439)

Single crystals of gadolinium metal were studied by the separate techniques of high field magnetization and ferromagnetic resonance. The former showed the adequacy of a molecular field model description while the latter uncovered a significant change in g-factor at the ordering temperature. The consequences of the presence of a biquadratic exchange term in addition to the usual bilinear one and of the formally related exchange-striction were examined in two publications. This work focuses attention upon modifications to molecular field model predictions and yields functional relations for hitherto unexplained magnetic behaviors that occur very widely in nature. Research into the antiferromagnetism of a number of layer-like compounds has continued with the general goal of evaluating exchange interactions from their behavior in high magnetic fields. Apart from the explorations of metamagnetic behavior, two new phenomena have been observed: the presence of Van Vleck type paramagnetic susceptibility in fields higher than those required for "ordinary" saturation of the antiferromagnetic system, and a nonlinear (concave upwards) low-temperature transverse magnetization curve below saturation. Author

N64-25595 Aberdeen Proving Ground, Md. Ballistic Research Labs.
RESISTANCE CHANGES CAUSED BY VAPORIZATION WAVES IN EXPLODING WIRES
F. D. Bennett, G. D. Kahl, and E. H. Wedemeyer Feb. 1964 28 p refs
(BRL-1241; AD-601333)

The marked increase in electrical resistance occurring at temperatures above melting can be explained by assuming a vaporization expansion wave proceeding radially inward from the wire surface. This wave reduces the conducting cross section of the wire, thereby increasing the resistance. For wires well matched to the circuit the resistance rise occurs when the condenser voltage is practically zero and can be neglected; and for thin wires that explode rapidly on the linear portion of the current curve, condenser voltage can be taken as constant. Under these assumptions the circuit equation can be integrated and explicit expressions obtained for current, power, and deposited energy. The required velocity of the wave, deduced from data on copper wires, is about 250 meters per second, an order of magnitude smaller than sound speed. A theoretical fluid dynamical model of an expansion wave involving a phase change from liquid to wet vapor is investigated; this analysis shows the expected velocity of small amplitude waves to be very close to the experimental value cited. Author

N64-25599 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Institut für Strahlantriebe
ADVANCES IN CONTINUOUS ELECTROMAGNETIC PROPULSION SYSTEMS [FORTSCHRITTE BEI KONTINUIERLICHEN ELEKTROMAGNETISCHEN ANTRIEBSANLAGEN]
Günther F. Au Repr. from Luftfahrttechnik-Raumfahrttechnik, v. 9, no. 3, 4, 6, 9, 1963 20 p refs
(DFL-232)

Continuous electromagnetic propulsion systems are of particular interest for space flight since they, by means of a comparatively high thrust, provide a suitable escape velocity whereby the optimum payloads can be delivered for orbital transitions in the earth–moon domain. This report presents a literature survey of the various problem areas, which have been clarified by theoretical and practical investigations. These problem areas are as follows: (1) the development of efficient engines; (2) the two-component arc plasmas; (3) the heat-transfer characteristics of gases: (4) the stabilization of arc plasmas; and (5) continuous plasma acceleration in electromagnetic fields (plasma acceleration in crossed electric and magnetic fields, the three-fluid theory of plasma acceleration in crossed electric and magnetic fields, a moving field accelerator, and loss mechanisms). Also, the motion of an electrically charged particle in crossed electric and magnetic fields is discussed. I.v.L.

N64-25612 Rochester U., N.Y.
EQUIVALENCE BETWEEN FOUR-FERMI AND YUKAWA COUPLING AND THE $Z_3 = 0$ CONDITION FOR COMPOSITE BOSONS
D. Lurie and A. J. Mac Farlane 24 Jun. 1964 61 p refs
(Contract AT(30-1)-875)
(UR-875-41)

The principal objective of the present work is the derivation of conditions for equivalence (1) between a four-Fermi theory with pseudoscalar coupling and a Yukawa theory with pseudoscalar bosons, and (2) in the corresponding vector case. In general, two conditions are found to be both necessary and sufficient. The first is a condition for the existence of an appropriate boson bound state in the four-fermi theory. The second condition is that the boson wave function renormalization constant, Z_3, in the Yukawa theory be equal to zero. Results are derived by consideration of fermion-fermion scattering in the chain approximation, and are proved valid to all orders in perturbation theory. Also discussed are the degenerate vacuum theories of Nambu and Jana–Lasinio and of Bjorken in the chain approximation. Author

N64-25628 National Lead Co. of Ohio, Cincinnati Technical Div.
[INSPECTION AND ANALYSES OF MATERIALS FOR NUCLEAR REACTOR FUEL CORES] Summary Technical Report, 1 Jan.–31 Mar. 1964
S. Marshall, M. A. Desesa, and R. Burgett, ed. 28 Apr. 1964 72 p refs
(Contract AT(30-1)-1156)
(NLCO-905) OTS: $1.75

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9. THE DISSOLUTION OF ALUMINUM-URANIUM ALLOYS BY THE NITRIC ACID-MERCURIC NITRATE SYSTEM T. P. Scheidler and N. R. Leist p 61–64 refs

10. THE REDUCTION OF URANIUM OXIDES IN A THERMAL ION PLASMA F. E. Jenkins and C. J. Oblinger p 65–76 refs

N64-25630 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
ON THE STABILITY OF THE EQUILIBRIUM SOLUTIONS OF THE PLANE RESTRICTED THREE BODY PROBLEM IN THE SENSE OF LIAPOUNOV Final Report
Samuel E. Moskowitz Apr. 1964 28 p refs
(Contract AF 49(638)-814)
(R64SD34; AFOSR-TR-64-0861; AD-438857)

The stability of the five equilibrium solutions of the plane restricted three-body problem is investigated in a topological sense of Liapounov. This aspect of motion has always been a subject of considerable interest primarily because the stability criteria were derived from linearizing the dynamical equations. The question cannot be resolved by means of existing theorems governing the first approximation, since these cases belong to an exceptional class, termed critical by Liapounov. The stability of the equidistant positions and instability of the collinear solutions are established, however, in accordance with a less restrictive definition by using surfaces formed from the Jacobi integral. Author

N64-25633 Naval Research Lab., Washington, D.C. Metallurgy Div.
ENCAPSULATION TECHNIQUES FOR NRL IRRADIATION EFFECTS STUDIES Progress Report
L. E. Steele and J. R. Hawthorne Dec. 1963 23 p refs
(NRL-MEMO-1481; AD-430751)

A capsule design philosophy has evolved that is based upon the use of two types of capsules, sealed units and externally controlled units, for the irradiation of large numbers of metallurgical specimens under a range of thermal and nuclear conditions. The basic philosophy of capsule design is described, along with specific techniques utilized for various test reactor capsules and for long-term power reactor surveillance capsules. Author

N64-25641 Maryland U., College Park Inst. for Molecular Physics
INSTITUTE FOR MOLECULAR PHYSICS FINAL REPORT FOR THE PERIOD 1 SEPTEMBER 1960 THROUGH 30 NOVEMBER 1963
[1963] 208 p refs
(Contract Nonr-595(14))
(AD-438051)

The recently reported accurate data of Herzberg and Howe have been used to calculate the potential energy curves for the $X^1\Sigma_u^+$ and $B^1\Sigma_u^+$ states of hydrogen by the Rydberg–Klein-Rees (RKR) method. The results are compared with those of the quantum calculations of Kolos and Roothaan, and Dalgarno and Lynn. The agreement is good; in fact, the interaction energy obtained by Dalgarno and Lynn for the ground state agrees with the RKR values to within 2% in the region where the two curves overlap. The rotational predissociation observed in the $v'' = 14$ level of the $X^1\Sigma_u^+$ state is discussed. There may exist here an unusual case of a sharp spectral line associated with a state that is very close in energy to the maximum of a potential barrier. Author

N64-25643 Comitato Nazionale per L'Energia Nucleare, Frascati (Italy)
POSSIBLE DETERMINATION OF THE η° LIFETIME WITH ELECTRON-POSITRON COLLIDING BEAMS
E. Celeghini and R. Gatto 24 Apr. 1964 11 p refs *Its* Nota Interna No. 239
(LNF-64/15)

Experiments with colliding electron–positron beams, now in the preparatory stage in several laboratories, may allow a determination of the η° lifetime. The following two reactions are discussed: (1) $e^+ + e^- \rightarrow \eta^\circ + \gamma$ and $e^+ + e^- \rightarrow \eta^\circ + \pi^+ + \pi^-$. Both reactions are thought to occur through single photon exchange. From the first reaction, the $\eta \rightarrow 2\gamma$ vertex with one photon off-mass shell and with a squared four-momentum $K^2 = -4E^2$, where E is the colliding beam energy (2E is the total center-of-mass energy) can be measured. From the second reaction the $\eta^\circ \rightarrow \gamma + \pi^+ + \pi^-$, again with the photon off-mass shell and with $K^2 = -4E^2$, can be measured. Reasonable assumptions on the momentum dependence of the relevant form factors are made in order to relate the off-mass shell behavior of the $\eta^\circ \rightarrow 2\gamma$ and $\eta^\circ \rightarrow \gamma + \pi^+ + \pi^-$ vertices to their values for real photons, which determine the partial lifetimes for these decay modes. Specifically, it is assumed that the form factors are essentially determined by the resonant intermediate vector states (ζ and ω). I.v.L.

N64-25645 General American Transportation Corp., Niles, Ill. MRD Div.
THEORETICAL STUDY OF ENERGY DISTRIBUTION IN A HALF-SPACE RESULTING FROM DYNAMIC LOADING IN A DEPRESSION AT THE ORIGIN
G. L. Neidhardt Kirtland AFB, N. Mex., Res. and Technol. Div. Mar. 1964 62 p refs
(Contract AF 29(601)-5813)
(RTD-TDR-63-3125; AD-438711)

An analysis of the free-field ground motion in the elastic region due to the energy delivered directly to the ground by a nuclear weapon is presented. The problem is approached along two different lines. One of these approaches treats the elastic region as a cratered half-space, where the hemispherical boundary of the crater is subjected to the pressure history exerted by a hydrodynamic region within the crater. The other approach treats the elastic region as a complete half-space, a portion of which has initial motion and pressures corresponding to the state of the hydrodynamic region at some instant when its behavior is becoming more nearly elastic than hydrodynamic. For the cratered-half-space approach, exact analytical expressions are obtained for the stresses at the wavefront, and numerical results based on these expressions are presented. For the complete-half-space approach, analytical results alone are obtained. Author

N64-25646 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
RESEARCH AND DEVELOPMENT ACTIVITIES. FIXATION OF RADIOACTIVE RESIDUES Quarterly Progress Report, Jan.–Mar. 1964
A. M. Platt Apr. 1964 40 p refs
(Contract AT(45-1)-1350)
(HW-81862) OTS: $1.00

The current program status includes the following: (1) Four "glass" samples were prepared from a simulated Purex waste spiked with massive quantities of radiocerium. (2) "Cold" laboratory studies on "glass" formulations showed variations in drip temperature as a function of fission-product content and sulfate-phosphate content. (3) Capacity studies on the mockup of the 12-in. spray calciner proposed for the waste solidification prototype verified the desired capacity of 10 gph. (4) Computer studies showed that the maximum size for a container for radioactive material may be limited by transient conditions during fixation–stabilization rather than by equilibrium storage conditions. (5) Pilot plant pulse columns using (4-sec-butyl-2-[α-methylbenzyl]phenol) to extract cesium from Purex alkaline waste were satisfactorily completed. (6) Laboratory studies were conducted to evaluate several methods of eliminating or minimizing the ammonium ion in the scrub effluent from zeolites loaded with cesium from Purex supernatant waste. (7) The temperatures that would be experienced in solidifying wastes in large underground tanks were predicted. (8) Electrodialysis and electrode-ionization techniques for the removal of Ru from intermediate-level wastes are being examined. I.v.L.

N64-25647 Comitato Nazionale per l'Energia Nucleare Frascati (Italy)
ON THE UTILIZATION OF THE LINAC TO PERFORM EXPERIMENTS WITH PIONS [SULLA UTILIZZAZIONE DEL LINAC PER EFFETTUARE DELLA SPERIMENTAZIONE CON PIONI]
C. Schaerf 18 Mar. 1964 8 p refs In ITALIAN *Its* Nota Interna no. 240
(LNF-64/16)

The use of a high capacity linear acceleration for the production of pions is described. Trans. by P.F.E.

N64-25648 RAND Corp., Santa Monica, Calif.
SOLUTIONS OF THE THOMAS-FERMI-DIRAC STATISTICAL MODEL OF ATOMS
Richard Latter Apr. 1964 46 p refs
(P-2783; AD-438434)

Numerical integration of the Thomas–Fermi–Dirac equation on the IBM 701 was carried out for atomic numbers Z = 1 to 100. Compressed, expanded, and isolated atoms were treated, the latter using the boundary condition suggested by Jensen. Tables of the solutions are given for all isolated atoms and for selected values of Z in the case of compressed and expanded atoms. The physical properties of interest for isolated atoms and the pressure–volume relationship for compressed and expanded atoms are presented tabularly. Other physical properties are presented graphically. Author

N64-25652 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
PROCUREMENT OF ZIRCALOY-2 PROCESS TUBES FOR N-REACTOR
R. C. Aungst and D. H. Curtiss Mar. 1964 82 p ref
(Contract AT(45-1)-1350)
(HW-80566) OTS: $2.00

An industrial capability has been developed for the fabrication of large heavy-walled Zircaloy-2 process tubes for N-Reactor. This was done by cooperative technological development among a number of fabricators and by the evolution of contracting procedures that put progressively greater responsibility on the vendor. Eventually 1,064 finished N-Reactor process tubes were delivered by three vendors under four contracts. Tube quality was excellent with less than 3% being rejected by rigorous inspection procedures not required of the vendor at his plant. Author

N64-25656 Carnegie Inst. of Tech., Pittsburgh, Pa.
THE MAGNETIC SUSCEPTIBILITY OF $FeCl_2$-$4H_2O$ FROM 0.35°K TO 4.2°K
J. T. Schriempf and S. A. Friedberg 16 Mar. 1964 37 p refs Presented at Conf. on Magnetism and Magnetic Mater., Atlantic City, Nov. 1963 and before Am. Phys. Soc., Philadelphia, Mar. 1964 Submitted for Publication
(Contract Nonr-760(05))
(TR-20; AD-439394)

The magnetic susceptibility of $FeCl_2$-$4H_2O$ in powder and in single crystal form has been measured between 0.35° and 4.2° K by an audiofrequency mutual inductance technique. Temperatures below 2° K were achieved with a liquid He^3 bath. These measurements show $FeCl_2$-$4H_2O$ to be an antiferromagnet with $T_N \sim 1°$ K. With the aid of crystallographic evidence, it has been found possible to fit the data in the paramagnetic region with a detailed picture of the lowest spin quintet of the Fe^{++} ion in a monoclinic crystalline field. The same level scheme describes adequately the measured specific heat of the salt in this region. The analysis performed for $T > T_N$ combined with the data for $T < T_N$ suggests that a four sublattice model may be necessary to interpret in detail the measurements in the ordered state. Author

N64-25657 Massachusetts Inst. of Tech., Cambridge, Mass.
THERMODYNAMIC CONSIDERATIONS IN CONTINUUM MECHANICS
Hans Ziegler [1964] 85 p refs Prepared in Cooperation with AIAA

Continuum mechanics is the theory of the mechanical behavior of deformable bodies. It is concerned with the deformations of elastic and plastic solids, with the flow of perfect and viscous fluids, and with viscoelastic, viscoplastic, and numerous other types of continua. The mathematic apparatus described for studying thermodynamic considerations in continuum mechanics is simple and concise. Cartesian tensors are used that are restricted to the right-handed coordinate system. The basic and relevant material from tensor calculus, continuum mechanics, and thermodynamics is briefly reviewed.

the thermodynamic concepts are then incorporated into those of continuum mechanics. R.T.K.

N64-25658 Melabs, Palo Alto, Calif.
INVESTIGATION OF MICROWAVE NON-LINEAR EFFECTS UTILIZING FERROMAGNETIC MATERIALS Eighth Quarterly Progress Report, 17 Nov. 1963–16 Feb. 1964
Lee F. Donaghey [1964] 18 p refs
(Contract DA-36-039-SC-89206)
(QPR-8; AD-438185)

The derivation of the overlap integral expressing the coupling coefficient between a pair of magnetostatic modes in a ferrite sphere is reviewed. The analysis is extended to the generalized ellipsoid with Gilbert damping terms incorporated in the general equations of motion for the magnetization Experimental work in progress on the longitudinal pumping of a YIG disc under orthogonal detuning is discussed. Author

N64-25662 Ohio State U., Columbus
LOW-ENERGY ABSORPTION AND BREMSSTRAHLUNG CROSS SECTIONS FOR NITROGEN
Robert De Vore 31 Dec. 1963 73 p
(Contract AF 33(657)-10426)
(Rept.-1565-5; AD-439392)

Source functions, from which absorption and bremsstrahlung cross sections are readily found, were computed for the nitrogen atom and ion in their ground states. The Maxwellian-averaged absorption cross section was also evaluated as a function of electron temperature and frequency. The wavelength interval is from 9μ to 2mm for electrons with initial momenta from 0.05 to 0.60 au. The Hartree–Fock potential was used in both calculations. The averaged absorption cross sections are compared with those of the hydrogen atom and ion. Author

N64-25665 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)
VACUUM PROBLEMS OF ELECTRON STORAGE RINGS
M. Bernardini and L. Malter 20 Mar. 1964 34 p refs *In its* Nota Interna no. 243
(LNF-64/19)

The problem of gas evolution in electron–positron storage rings due to synchrotron radiation was explored. The spectral distribution of the radiation was first computed. From this and from data on quantum efficiency it was possible to determine an upper limit to the resultant photoemission from the ring walls. Measurements of the desorption efficiency from stainless steel n. 304 then made possible a determination of the maximum gas load that could be expected as a result of the synchrotron radiation. Author

N64-25670 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)
POSSIBLE METHOD TO DETERMINE THE η^0 LIFETIME
E. Celeghini and R. Gatto 23 Apr. 1964 7 p refs *Its* Nota Interna No. 238
(LNF-64/14)

The process, $\gamma + p \rightarrow n + \eta^0 + \pi^+$, is discussed in view of the possible utilization of its peripheral production contribution for a determination of the η^0 lifetime. From experiments performed above a 2- to 3-Bev incident photon momentum, it is indicated that the peripheral contribution may in fact be easily detected and may provide an excellent determination of the η^0 lifetime. I.v.L.

N64-25671 Comitato Nazionale per l'Energia Nucleare, Frascati (Italy)
PROGRAMS FOR CALCULATING 2- AND 3-BODY REACTION KINEMATICS ON THE IBM 1620 [PROGRAMMI DI CALCOLO DELLE CINEMATICHE DELLE REAZIONI A DUE CORPI E A TRE CORPI PER IL CALCOLATORE IBM 1620]
G. Verri 27 May 1964 17 p In ITALIAN
(LNF-64/23)

Computer programs for calculating the kinematics of the two-body and three-body problem for the IBM 1620 computer are described. Trans. by P.F.E.

N64-25696 Pennsylvania U., Philadelphia
PROBLEMS AND REMARKS CONCERNING THE LIFTING PROPERTY Technical Report
A. Ionescu Tulcea and C. Ionescu Tulcea Sep. 1963 24 p refs
(Contract DA-ARO(D)-31-124-G218)
(AROD-3333-9; AD-601439)

This report shows how several problems concerning the lifting property were formulated. Definitions and notations concerning the theory of integration, particularly for locally negligible, locally integrable, and essentially integrable equations, are presented in terms of linear lifting, strong lifting, proper mapping, the Dunford–Pettis theorem, linear mapping, and locally null. G.D.B.

N64-25702 Michigan U., Ann Arbor Electron Physics Lab.
DIGITAL COMPUTER ANALYSIS OF CROSSED-FIELD ELECTRON GUNS
J. E. Boers Apr. 1964 83 p
(Contract AF 33(615)-1553
(TR-71; AD-601959)

A digital computer program written in the IBM 7090 FORTRAN programing system is described and then employed in the analysis of several crossed-field guns. The digital program employs relaxation techniques while alternately computing electric fields and trajectories. One cycle through the program consists of three basic parts: (1) calculation of the volages within the gun by solving Poisson's equation, in difference form, on a 7200 point matrix on which electrode potentials are laid out; (2) calculations of new current densities along the cathode and the setting up of trajectory starting points along the cathode to simulate these densities; and (3) calculation of trajectories and comparison of the new beam with the previous one. Author

N64-25713* New York U., N.Y.
QUANTUM MECHANICAL STUDY OF MOLECULES: ELECTRONIC STATES OF DIATOMIC MOLECULES
Roop C. Sahni Washington, NASA, Jul. 1964 49 p refs
(Grant NsG-76-60)
(NASA-TN-D-2363) OTS: $1.25

This paper outlines the theory of the molecular orbital method for ground, ionized, and excited states of molecules. A brief summary of the interaction integrals and their tabulation is given. An automatic program designed for the computation of various states of molecules is outlined. Examples of the study of ground, ionized, and excited states of CO, BH, and N_2 molecules where the programs of automatic computation and molecular integrals were used are presented. Author

N64-25727 Massachusetts Inst. of Tech., Cambridge Fluid Mechanics Lab.

A KINETIC THEORY APPROACH TO ELECTROSTATIC PROBES

Eliahu Wasserstrom, C. H. Su, and Ronald F. Probstein May 1964 73 p refs

(Contract Nonr-1841(93))

(AD-441726)

A spherical electrostatic (Langmuir) probe in a slightly ionized plasma is studied from a kinetic theory point of view. The two-sided distribution function method of Lees, which embodies the Mott–Smith approach, is used. The velocity space is divided into two regions along the straight cone tangent to the spherical probe, and different distribution functions are defined in the two regions. On satisfying the two relevant moments of the distribution function (continuity and number-density flux) three simultaneous ordinary nonlinear differential equations, which are appropriate to all values of the Debye length, collision mean free path and probe potential, are obtained for determining the ion and electron number densities, and the potential. These equations reduce to the usual linear flux equations when the mean free path is much shorter than the probe radius and the Debye length. The equations are first linearized and solved for the case of small probe potential. Explicit solutions are given for the current–voltage characteristics and the distributions of the number densities and the potential. Author

N64-25732 Space Technology Labs., Inc., Redondo Beach, Calif. STL Technical Library

QUANTIZATION OF SIGNALS WITH NONUNIFORM STEPS [KVANTOVANIE SIGNALOV S NERAVNOMERNYM SHAGOM]

V. A. Garmash Feb. 1964 7 p refs Transl. into ENGLISH from Electrosvyaz (USSR), no. 10, 1957 p 10–12

(STL-TRANS-80)

The process of quantization of a signal consists of the substitution of a discrete signal for a continuous one. In this report, a feedback relation is obtained that makes it possible to construct a quantization scale for the reduction of quantization noise. The example considered is the quantization of signals whose density of probability distribution satisfies the exponential law

$$p(x) = 1/\sqrt{2}\ e^{-\sqrt{2}|x|}$$

I.v.L.

N64-25740 RAND Corp., Santa Monica, Calif.

INVARIANT IMBEDDING AND THE INTEGRATION OF HAMILTON'S EQUATIONS

Richard Bellman and Robert Kalaba Feb. 1963 23 p refs

(Contract AF 49(638)-700; Proj. RAND)

(RM-3538-PR; AD-602269)

Based on earlier work on the application of the principle of invariant imbedding to problems in transport theory, a countercurrent flow model is described that can be associated with any mechanical process described by Hamilton's equations of motion. The determination of certain reflection and transmission functions, which occur naturally in the transport process, leads to the solution of Hamilton's equations. Some examples and some possible future applications are given. Author

N64-25744 RAND Corp., Santa Monica, Calif.

THE EXISTENCE AND UNIQUENESS OF THE SOLUTION TO A PROBLEM IN INVARIANT IMBEDDING

T. A. Brown Apr. 1964 18 p refs

(Contract AF 49(638)-700; Proj. RAND)

(RM-4075-PR; AD-436732)

This report establishes the existence and uniqueness of a solution to the following system of nonlinear ordinary differential equations: $r' = (F - 1)r + By - \phi(y,r), y' = -Br + (1 - F)y + \phi(y,r)$ under the boundary conditions, $r(0) = 0$, $y(t_0) = y_0 > 0$, given certain natural conditions on ϕ. The independent variable t represents the length along the rod, y represents the flux from right to left at a point t, and r represents the flux from left to right. The parameters B and F are nonnegative constants representing the effects of backward and forward scattering, with $B + F \leq 1$. The quantity $\phi(y, r)$ represents the rate of absorption loss in both the forward and backward streams as a result of stream interactions. The rod is considered as being of some finite length t_0, with no flux falling upon the left-hand end and with flux y_0 falling upon the right-hand end. I.v.L.

N64-25751 Philco Corp., Blue Bell, Pa. Research Labs.

THIN FILM ACTIVE DEVICES Final Report, 22 Jun.–30 Sep. 1963

James P. Spratt 20 Feb. 1964 65 p refs

(Contract DA-49-186-ORD-1056)

(A046-F; AD-602043)

A semiquantitative analysis was performed of methods of collection of hot electrons at an internal potential barrier; such collection may be unlikely for electrons injected by any but a Schottky barrier emitter, and that even this type of emission is not too promising. An experiment was devised to confirm the above analysis of hot electron collection. This experiment involves studying the transmission through thin metal films of low energy electrons from an electron gun. It has many advantages over the study of internal photoemission, but has the disadvantage that the minimum electron energy achievable is approximately 2 electron volts above the Fermi level of the metal. A study of fabrication techniques for the production of thin layers of aluminum oxide was conducted to develop tunnel junctions and insulating layers. Thermal oxidation of aluminum was unsatisfactory because of the high incidence of shorts. Reactive evaporation of aluminum in an oxygen atmosphere gave best results if the oxygen pressure and deposition rate were controlled. A study was conducted of the feasibility of a controlled tunnel-emission triode. Author

N64-25757 New York U., N.Y. Div. of Electromagnetic Research

A PLANE WAVE EXPANSION THEOREM FOR CYLINDRICALLY RADIATED FIELDS

S. N. Karp and N. R. Zitron May 1964 18 p refs

(Contract AF 19(628)-3868)

(EM-199; AFCRL-64-426; AD-602236)

An asymptotic expansion for two-dimensional outwardly radiating fields is developed from an integral representation of these fields by means of a saddle point integration. The expansion is given in terms of inverse powers of the distance from a point in a fixed region A to a point in a circular neighborhood at a large distance from A. The coefficients are expressed in terms of plane waves and linear combinations of derivatives of plane waves with respect to angle-of-incidence. The theorem may be employed in scattering problems in reducing scattering of arbitary two-dimensional fields by arbitrary cylinders to scattering of plane waves by the arbitrary cylinders. Author

N64-25759 European Atomic Energy Community, Brussels (Belgium)
THE FAST NEUTRON MULTIPLICATION FACTOR
L. Amyot Joint Nucl. Res. Center, ISPRA Estab. (Italy) Mar. 1964 20 p refs Presented at the Convegno di Fis. Dei Reattori, Milan, 29–30 Nov. 1963
(EUR-1618.e) Available from Belgian Am. Bank and Trust Co., N.Y., Account No. 121.86: 40 Belg. Fr.

A general formulation is given for the fast neutron multiplication factor in which the spatial effects are expressed in terms of first collision probabilities and the energy dependence in terms of multigroup equations. The nonuniformity of the fission flux distribution, the effects of backscattering from the moderator and rod-to-rod interaction, the heterogeneous composition of the fuel element, the photoneutron production in the moderator are all explicitly taken into account. As given in the present paper this definition of ϵ is especially suitable for cluster-type fuel elements but may be applied without difficulty to other geometrical configurations. Author

N64-25779 Pennsylvania State U., University Park. Ionosphere Research Lab.
A MATHEMATICAL TECHNIQUE FOR THE CONVERSION OF WAVE INTERACTION DATA TO ELECTRON DENSITY PROFILES Scientific Report
F. V. Hellrich 20 Sep. 1964 80 p refs
(Grant NSF-GP-846)
(SR-220)

In this report, three methods for the conversion of amplitude and phase interaction data to electron density profiles are developed. Each method, using an iterative least square error technique, synthesizes electron density profiles of one of the three functional forms—the exponential, the quadratic, and the piecewise linear. All of the methods are evaluated with respect to the errors that may be produced in the synthesized profile arising from uncertain values of collision frequency, disturbing pulse power, energy loss coefficient, and coefficients of interaction. Also a demonstration of the effectiveness of the combined use of amplitude and phase interaction in producing a more accurate profile than could be obtained with amplitude data alone is presented. The piecewise linear method is the most suitable for the reduction of actual interaction data, and its ability to synthesize electron density profiles with valleys is established. Author

N64-25783 Comitato Nazionale der L'energia Nucleare, Frascati (Italy)
SOME CONSIDERATIONS ON THE MAXIMUM AMOUNT OF INFORMATION OBTAINABLE FROM ELECTRON COLLIDING BEAMS EXPERIMENTS Nota Interno No. 245
C. Pellegrini and C. Schaerf 29 May 1964 5 p refs
(LNF-64/25)

The purpose of this report is to illustrate that it is necessary to perform experiments at certain angles and energies, with both electron–positron and electron–electron colliding beams, in order to obtain a maximum of information on the electromagnetic form factors of particles and on the limit of validity of quantum electrodynamics (QED). Three reactions are considered: (1) $e^+ + e^- \rightarrow a + \bar{a}$, (2) $e^+ + e^- \rightarrow e^+ + {}^-$, and (3) $e^- + e^- \rightarrow e^- + e^-$, where, for simplicity, it is assumed that a is a spin zero particle. After subtraction of the radiative corrections and neglecting the contributions from the two-photon channel, the cross section for the three reactions can still differ from the one calculated in the first Born approximation. Following the conventional procedure, the following are introduced: a form factor $F_a(q^2)$ for the $\gamma a\bar{a}$ vertex, a form factor $F_e(q^2)$ to describe the effect of a breakdown of QED at the γe^+e^- vertex in (2), a function $P_b(q^2)/q^2$ for a similar breakdown of the photon propagator, and a function $P_v(q^2)/q^2$ for the change in the photon propagator due to vacuum polarization. I.v.L.

N64-25815 Technical Operations Research, Burlington, Mass.
MONTE CARLO COMPUTATION OF 100,000 p-MeV GAMMA RAYS SCATTERED BY CONCRETE SLABS Final Report
Dominic J. Raso Mar. 1964 75 p ref
(Contract NBy-32237)
(TO-B-64-31; AD-438908)

Monte Carlo calculations were performed to determine the backscattering of 1.0 Mev gamma rays from concrete and their transmission through slabs of this medium. The radiation was assumed to be incident at various angles θ_0 (Cos θ_0 = 1.0, 0.75, 0.50, 0.25, and 0.10) on a semi-infinite medium and on slabs with thicknesses of 0.55, 1.1, 2.2, and 4.4 mfp. Case histories of 100,000 photons were followed in groups of 20,000 on an IBM 7094 digital computer for each of the six incident angles. Differential dose and number distributions as a function of azimuthal and polar angles are reported. Author

N64-25817 California U., Berkeley Lawrence Radiation Lab.
PROPOSED MOLECULAR BEAM DETERMINATION OF ENERGY PARTITION IN THE PHOTODISSOCIATION OF POLYATOMIC MOLECULES
Richard N. Zare and Dudley R. Herschbach 29 Jan. 1964 56 p refs
(Contract W-7405-ENG-48)
(UCRL-11359) OTS: $1.25

Conventional photochemical experiments give no information about the partitioning of energy between translational recoil and internal excitation of the fragment molecules formed in photodissociation of a polyatomic molecule. In a molecular beam experiment, it becomes possible to determine the energy partition from the form of the laboratory angular distribution of one of the photodissociation products. A general kinematic analysis is worked out in detail, and the uncertainty introduced by the finite angular resolution of the apparatus and the velocity spread in the parent beam is examined. The experimental requirements are evaluated for the photolysis of methyl iodide by the 2,537 A Hg line. Author

N64-25825 Rochester U., N.Y.
THE TRIALITY QUANTUM NUMBER IN SU(3) AND U(3) SYMMETRY AND ITS APPLICATION TO WEAK INTERACTIONS
S. Okubo, C. Ryan, and R. E. Marshak 5 Jun. 1964 20 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-37)

The definition of the triality quantum number in both the SU(3) and U(3) groups is investigated in connection with the problem of fractionally charged particles. To describe a triplet of particles having integral values of charge and hypercharge, it is necessary and sufficient to use the group U(3) rather than the group SU(3). The possibility that leptons may belong to unitary triplets in weak interactions was investigated. Author

N64-25826 Rochester U., N.Y.
TENSOR METHODS AND A UNIFIED REPRESENTATION THEORY OF SU_3
N. Mukunda and L. K. Pandit 11 Jun. 1964 63 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-38)

Starting with irreducible tensors, an explicit construction of orthonormal basic states for an arbitrary unitary irreducible representation (λ,μ) of the group SU_3 is developed. A knowledge of the simple properties of the irreducible tensors can then be exploited to obtain a variety of results, which ordinarily require more abstract algebraic methods for their derivation. As illustrative applications, Biedenharn's expressions for the matrix elements of the generators of SU_3 are derived, the matrix elements of octet type operators for the case $(\lambda\mu)\rightarrow(\lambda,\mu)$ are computed, and an explicit unitary transformation connecting the isospin and the U-spin states in any arbitrary irreducible representation is developed. Author

N64-25827 Rochester U., N.Y.
SYMPLECTIC SYMMETRY IN $f_{7/2}$-SHELL NUCLEI
J. N. Ginnochio 26 Jun. 1964 41 p refs
(Contract AT(30-1)-875)
(UR-875-43)

The status of the conservation of symplectic symmetry in the nuclear $f_{7/2}$ shell is investigated (1) by comparing the two-body interaction with the most general symplectic-conserving interaction using an a priori criterion developed for the purpose, (2) by examining symplectic admixtures in the calculated nuclear wave functions, and (3) by studying the calculated symplectic energy bands. The interaction is determined from the best available data of the Sc^{42} spectrum. Except in special cases, symplectic symmetry is only very badly conserved and predictions based on a simple symplectic model are therefore invalid. Some comments are made concerning an alternative approach for studying the structure of the j^n configuration. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-24245 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
EXTRACTION OF IONS FROM PLASMA ION SOURCES AND PRIMARY FORMING OF IONIC BUNDLES
M. D. Gabovich 13 Dec. 1963 Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (USSR), no. 2, 1963 p 5-19
(FTD-MT-63-181; AD-437673) OTS: $3.60

Three methods are distinguished for extracting ions from plasma ion sources, depending on the position and shape of the emitting surface of the plasma. In ion sources with a relatively small degree of ionization of the gas medium (for example, high-frequency), extraction usually is produced by drawing ions from a plasma boundary located inside the ion sources, with subsequent transmission of the ion beam through a relatively long channel, limiting flow of neutral gas. In powerful ion sources with great concentrations of charged particles and a high degree of ionization, quasi-Pierce systems are applied in most cases; in these the emitting boundary of plasma lies near the plane of outlet. With a third method, ions are extracted from a well-developed plasma surface and are far beyond the limits of the ion sources in vacuum. Such systems receive ion beams with high current strength. Author

N64-24265 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE SOURCE OF HIGH TEMPERATURE PLASMA
Emil Zizka 10 Jan. 1964 11 p Transl. into ENGLISH of Czech. Patent No. 99196 15 Apr. 1961 p 1-3
(FTD-TT-63-1042/1+2; AD-428710)

A source of a high-temperature plasma is described. It consists of two ion sources, two ion accelerators, two electron guns to neutralize the space charge of the ion beams, and a magnetic cage. An array of the ion source is on each end of the magnetic cage, ion accelerator, and electron gun, aimed toward the cage center on the same line. Operation of the plasma source is described. D.E.W.

N64-24347 Aerospace Corp., El Sengundo, Calif. Aerodynamics and Propulsion Research Lab.
AIR PLASMA ARC MATERIALS TESTING FOR RE-ENTRY
D. H. Leeds, W. E. Welsh, J. I. Slaughter, and E. G. Kendall 17 Jun. 1964 58 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-75; TDR-269(4240-10)-11; AD-601808)

Materials research in a subsonic air plasma arc, delivering a cold wall heat flux of 700 Btu/ft^2-sec for 60 sec and a cold wall heat flux of 2,400 Btu/ft^2-sec for 30 sec, is described. Arc cast HfC-C, ZrC-C, TiC-C, TaC-C, TiB_2-B alloys are compared with commercially hot-pressed HfC-C, TiC-C, TaC-C alloys; infiltrated tungsten and sintered and forged tungsten; pressed and cast thoria and infiltrated thoria, pyrolytic and boron pyrolytic graphites; and with standards of comparison such as ATJ graphite and boron nitride. Pairs of motion pictures show a calibrated gray scale to give a brightness temperature profile, simultaneously with a record of material reactions. Measurements of mass ablation rates and longitudinal recession rates are compared. Hot and cold face temperatures on the flat faces of solid cylindrical specimens are noted. Metallographic analyses are given of areas of a section through the major axis of each specimen. The method of calibration of the arc tunnel for the series is detailed. Author

N64-24379 Tokyo U. (Japan) Aeronautical Research Inst.
AN EXPERIMENTAL STUDY ON A PLASMA FLOW THROUGH A MAGNETIC NOZZLE
Kyoichi Kuriki Mar. 1964 28 p refs *Its* Rept. 380 (v. 29, no. 2)

The interaction between a plasma flow and the magnetic field produced by a ring coil was investigated experimentally in order to confirm the channeling effect of the magnetic field. The plasma flow was produced in a quartz tube by an arc jet. Before imposing the magnetic field on the plasma flow, the flow conditions such as temperature, velocity, and static pressure were measured. The results show that the flow conditions change only very slowly along the stream, and that the flow is either subsonic or supersonic, depending on the arc current. The distributions of the wall pressure and gas luminosity were calculated numerically by a linearized theory, which assumes that there exists only a small effect of the magnetic field on the plasma flow, and which neglects the Hall effect and charge separation. In the measurements of the wall pressure distribution, a remarkable contrast between the case of a subsonic and a supersonic flow was observed, just as is predicted by the linearized theory. Author

N64-24593* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GENERALIZED TREATMENT OF PLANE ELECTROMAGNETIC WAVES PASSING THROUGH AN ISOTROPIC INHOMOGENEOUS PLASMA SLAB AT ARBITRARY ANGLES OF INCIDENCE
Calvin T. Swift and John S. Evans Washington, NASA, Dec. 1963 44 p refs
(NASA-TR-R-172) OTS: $1.25

The differential equations describing the passage of plane electromagnetic waves through a plane-parallel inhomogeneous plasma slab at an arbitrary angle-of-incidence are solved by numerical integration between appropriate boundary conditions. The methods used are described, and a typical solution is discussed. Author

N64-24645 Illinois U., Urbana Coordinated Science Lab.
ELECTRON COLLISIONS IN NEON PLASMA
C. L. Chen Apr. 1964 21 p refs
(Contract DA-36-039-AMC-02208(E))
(R-201; AD-439438)

The momentum transfer collision frequencies of electrons with neon ions and neutral atoms were measured in a decaying neon plasma over the temperature range from 200° to 600° K. The temperature–density dependence of the electron–ion collision frequency is determined to be

$$\nu_{ei} = 3.6\ n/T_e^{3/2} \quad \mathrm{Ln}2.0 \times 10^4 T_e^{3/2}/\ n^{1/2}.$$

The energy dependence of the momentum transfer cross sections of electrons with neon atoms is best represented by $Q_{m_1}(u) = 2.55 \times 10^{-16} u^{1/2}$ and $Q_{m_2}(u) = 1.07 \times 10^{-17} + 2.17 \times 10^{-16} u^{1/2}$ cm^2 for one- and two-term approximations, where u is the electron energy in electron volts. Author

N64-24669 Royal Inst. of Tech., Stockholm (Sweden)
EXCITATION OF BACKWARD WAVE MODES IN PLASMA WAVEGUIDES
B. Agdur and B. Enander *In its* Interaction between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 1–22 refs (See N64-24668 17-09)

The following are discussed: (1) excitation by a gap, (2) excitation by a given transverse field, and (3) influence of a drift velocity on dispersion curves. R.T.K.

N64-24674 Royal Inst. of Tech., Stockholm (Sweden)
VARIATION OF PLASMA PARAMETERS ALONG THE POSITIVE COLUMN OF A MERCURY DISCHARGE
J. Bach-Andersen and A. Nord *In its* Interaction between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 94–102 refs (See N64-24668 17-09)

Experimental studies of the variation of the electron density along the positive column of a low-pressure mercury discharge are described. The electron density was measured by means of the microwave cavity method. It is the purpose of this experiment to obtain more information on the axial variation of the plasma parameters by introducing Langmuir probes, so that the electron temperature and the axial d.c. electric field in the plasma can be measured. R.T.K.

N64-24675 Royal Inst. of Tech., Stockholm (Sweden)
EXPERIMENTS ON NOISE RADIATION FROM A PLASMA IN A WAVEGUIDE
B. Kerzar *In its* Interaction Between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 103–112 ref (See N64-24668 17-09)

The work reported here is a continuation of earlier experiments on noise radiation and coherent scattering from a low-pressure plasma column in free space and in a waveguide. The experiments are connected to the theoretical investigation. Previously published experimental data on noise radiation and scattering from a plasma column in free space and in a waveguide showed strong polarization of noise in the region of secondary peaks. The aim of this report is to present more experimental data on noise radiation from a cylindrical plasma column situated in a waveguide. Author

N64-24676 Royal Inst. of Tech., Stockholm (Sweden)
MICROWAVE EMISSION FROM A CYLINDRICAL PLASMA
P. Weissglas *In its* Interaction between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 113–121 (See N64-24668 17-09)

The plasma is described by means of hydrodynamic equations. The effect of the ions is included as a neutralizing background only. This model does not contain thermal fluctuations but is easy to handle when considering geometric complications. The scattering problem is dealt with and then Kirchhoff's law is used to give the fluctuation spectrum. Evidence is presented that indicates that the noise spectrum, as is shown for the scattering spectrum, is strongly modified by the nonhomogeneous radial density distribution. R.T.K.

N64-24863 Radio Corp. of America, Camden, N.J.
PLASMA-MICROWAVE INTERACTIONS
James Vollmer *In its* Systems Eng. and Space Technol. [1964] p 61–64 refs (See N64-24851 17-01)

This paper is concerned with plasma interactions with electron beams, electromagnetic waves, and magnetic fields. These interactions produce generation and amplification of power at super-high and extremely high frequencies. This radiation can be coherent or incoherent. Such interactions in combination with the high field capability of hard superconductors may lead to useful power at 1,000 Gc or higher. Potential uses of plasma devices are as transmitters, couplers, and maser pumps. The problems that must be solved first, however, include improved methods of plasma production and sensitivity of resonances to local environment. Author

N64-24864 Toronto U. (Canada) Inst. for Aerospace Studies
MECHANICS OF RAREFIED GASES AND PLASMAS A State-of-the-Art Survey of Some Aspects, Final Report
G. N. Patterson Mar. 1964 238 p refs
(Contract AF 33(616)-6990)
(UTIAS-18; AD-433613)

This report presents a survey of some aspects of the kinetic theory of rarefied gases (neutral molecules) and a brief introduction to the characteristics of ensembles of identical charged particles. Consideration is given to the derivation and properties of the Boltzmann equation. The special form of the Boltzmann equation for free molecule flow and the associated boundary conditions governing the distribution function are discussed. The latter involves the interaction of gas particles with surfaces. The subject of near-free-molecule flow is introduced by a consideration of molecular beams and the effect of collisions on beam strength. A review of molecular beam systems from the point of view of design is included. The Boltzmann equation has been reconsidered in detail for the more general case of an ensemble of identical charged particles; relativistic effects are included. Author

N64-24872 National Research Council of Canada, Ottawa Div. of Mechanical Engineering
ELECTRICAL CONDUCTIVITY OF INERT GASSES—SEED COMBINATION IN SHOCK TUBES
J. Lau Dec. 1963 57 p refs
(MT-51; NRC-7884)

The effect of seeding shock waves with alkali metal smoke is studied. The pressure, density, temperature ratio, electron density, and conductivity were calculated with a digital computer and tabulated for various combinations of gas and seeding material. A hydrogen-driven shock tube was constructed to measure the properties of the seeded gas behind the shock wave. Argon was chosen as the driven gas among the inert gases because of its well-known properties and its low speed of sound. Author

N64-24915 Electro-Optical Systems, Inc., Pasadena, Calif.
RESEARCH ON CESIUM VAPOR Annual Report, 1 May 1962–1 May 1963
A. O. Jensen 14 Jun. 1963 72 p refs
(Contract Nonr-3805(00))
(EOS-3130-Annual; AD-422661)

The results of an investigation into the absorption of resonance radiation in cesium vapor and the effect of resonance radiation on the ionization processes in cesium vapor plasmas are reported. A model for the dominant ionization processes is proposed that appears to be applicable to the cesium pressure range and other conditions found in cesium vapor thermionic converters. The atomic resonance absorption bandwidths at the 8,521 A and 8,943 A resonance lines are much greater than previously reported. A molecular absorption band near 7,600 A, which can contribute significantly to the energy input to a cesium vapor plasma, was also observed. Author

N64-25016 Avco-Everett Research Lab., Everett, Mass.
STUDIES OF SEED RECOVERY AND CORROSION IN COAL FIRED MHD POWER PLANTS
F. Hals, L. Keefe, and A. El Bindari Jun. 1964 35 p refs
(Avco-Everett Res. Rept.-182)

An easily ionizable material called seed must be added to the combustion products of fossil fuel to achieve a sufficient degree of ionization of the gases in the MHD generator. The problems of seed recovery and gas side corrosion effects due to seeding in coal fired MHD powerplants are of critical importance for successful economic realization of MHD power generation. Reported are the results of a study of these problems and these results are applied to an assessment of the economics of seeding in a coal fired MHD powerplant. The paper contains a survey of the problems, a description of a potential recovery method and of apparatus to experimentally study the recovery method, as well as corrosive effects due to seeding of the steam generator and oxidizer preheater utilizing the heat in the exhaust gases from the MHD generator. It presents experimental results indicating that efficient seed recovery is feasible with resultant favorable seed economics. The addition of seed is related to corrosion of metal heat-transferring surfaces, and interesting results achieved in this area from the experiments are described. Because the ionization potential is low and because of economic considerations, potassium has been selected as seed. The least expensive seeding compound, KCL, cannot be used due to the electronegative characteristics of the chlorine atom. It therefore becomes necessary to use more expensive seeding compounds, such as potassium sulphate, hydroxide, or carbonate. For economical operation it is essential that a large part of the seed be recovered. Author

N64-25034 Princeton U., N.J. Aeronautical Engineering Lab.
CALCULATION OF TRANSPORT PROPERTIES OF MIXTURES OF HELIUM AND PARTLY-IONIZED ARGON
Martin P. Sherman Dec. 1963 74 p refs
(Contracts AF 33(657)-9962; Nonr-1858(31); ARPA Order 206-61; Grant NsF-GP-579)
(AEL-673; AD-437625) OTS: $7.60 ph

Transport properties were calculated for equilibrium mixtures of helium and partly ionized argon as functions of temperature and helium concentration. Viscosity, thermal conductivity diffusion, and thermal diffusion data, as well as effective diffusion and thermal diffusion coefficients, are presented for temperatures up to 15,000° K and helium concentrations from 0% to 100%. The method was based on Chapman–Enskog theory, using collisional data from various sources for the different particle interactions. An alternate method based on a relaxation-time model was also used for viscosity calculations, and provided good correlation with the Chapman–Enskog results. Author

N64-25070* Consultants and Designers, Inc., Arlington, Va.
DISTRIBUTION OF ELECTRIC AND MAGNETIC FIELDS IN A ROTATING, THERMODYNAMICALLY EQUILIBRATED PLASMA
M. V. Samokhin 29 Apr. 1964 7 p refs Transl. into ENGLISH from Doklady Akademii Nauk SSSR (Moscow or Leningrad), v. 155, no. 1, 1964 p 72–74
(Contract NAS5-2078)
(NASA-TT-F-8690; ST-PP-GD-10-135)

The flow of a neutral gas in a state of thermodynamic equilibrium is composed of a translation advance and a rotational movement around a fixed axis. Assuming some external forces act upon the gas, but are not dependent on velocity, they have a potential, but the distribution of density is subject to the barometric formula. At the same time, the temperature does not depend on the coordinates, whereas the density varies in a direction perpendicular to the mean velocity of the gas. This paper discusses the distribution of electric and magnetic fields in a rotating, thermodynamically equilibrated plasma. G.D.B.

N64-25131 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
UTILIZATION OF CONFINING MAGNETIC FIELDS IN DUPLEXER APPLICATIONS
Maurice Weiner Feb. 1964 12 p refs
(USAELRDL-TR-2432; AD-435871)

The feasibility of using a magnetic field to improve the high-power performance of gas duplexing tubes is studied. Using available theory, the conditions for the prevention of electron and ion impact with the container walls are determined. One approach compares the sheath thickness and the Larmor radius of the electron. Another approach studies the possibility of the reversal of the sheath potential to retard ion impact. Results show that the method of plasma confinement by a magnetic field in duplexing tubes has limitations. Author

N64-25195 Los Alamos Scientific Lab., N. Mex.
EXPERIMENTAL OBSERVATION OF A CESIUM PLASMA DIODE WITH A NICKEL EMITTER
Walter H. Reicht 9 Jul. 1964 28 p refs
(Contract W-7405-ENG-36)
(LAMS-3086) OTS: $0.50

A variable cesium plasma diode has been equipped with a nickel emitter and used to investigate cell characteristics when the cell was operated in a driven, low-voltage discharge mode. Current densities, electron temperatures, and ion densities were determined as a function of cesium pressure and cell spacing. Emitter temperatures were in the vicinity of 1,000° K, since the data were intended for use in the extension of plasma propeller experiments. N.E.A.

N64-25351 General Applied Science Labs., Inc., Westbury, N.Y.
EFFECT OF TRANSMITTED RADIATION PATTERN ON THE RADAR RETURN FROM A PLASMA-CONTAINING INFINITE CYLINDER UNDER OBLIQUE ILLUMINATION
Frank Lane and Sulmo Mariano 13 Mar. 1964 73 p refs
(Contract NOw-63-0637-C(FBM))
(TR-387; AD-442766)

Backscattering by a plasma-containing infinite cylinder is analyzed. The cylindrical configuration is assumed to contain a uniform plasma (constant electron density); the incidence is permitted to be oblique, but the transmitted-pattern major axis is assumed to intersect the cylinder center line. The point of intersection defines the origin of the cylinder-fixed (x y z) coordinate system. The radar-fixed coordinate system is denoted by x' y' z'. The incident or transmitted wave is expressed analytically (Fourier analysis). These general expressions are then, written for the transforms of the internal (inside the plasma) and scattered fields. The tangential components of the $\vec{H}$ and $\vec{E}$ transforms are matched up at the cylinder boundary ($r = r_p$), and the transform of the scattered field is thereby determined in terms of the transmitted or incident field. Finally, an analytical expression is derived for the pattern-weighted, received signal, and the relation of this signal to the far field of the transmitted pattern is pointed out. The results obtained make it possible to determine the effects of backscattering for obliquely incident situations and to give the actual signal received in terms of the original transmission pattern. I.v.L.

N64-25379 Elcon Lab. Inc., Peabody, Mass.
DESIGN AND EVALUATION OF AN ION BEAM DELAY LINE Final Report
Robert C. Siegel and Edwin Landberg 30 Apr. 1964 79 p refs
(Contract AF 19(628)-2762)
(R-4-64-3; AFCRL-64-373; AD-601898)

The theory and evaluation of a signal delay technique based on the travel time of an ion beam through an equipotential drift space filled with plasma are examined. Attention is given to plasma potential distribution and the control of particle trajectories by the use of magnetic and electrostatic-sheath focusing. Emission characteristics of nickel and tungsten in a cesium environment, sheath phenomena, space-charge neutralization, design data, construction techniques, and evaluation tests are described in detail. Results indicate the basic soundness of the ion beam delay line concept. Ultimate characteristics of a tube using this technique could reasonably include bandwidths from d.c. to 40 mc or higher, voltage-controlled delay from several microseconds to a millisecond, low insertion loss, and a noise level no greater than that due to the random fluctuation of ion current.
Author

N64-25449 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CONDITIONS OF MAXIMUM AMPLITUDE OF A NUCLEAR-RESONANCE SIGNAL IN A FLOW-THROUGH PICKUP
A. I. Zhernovoy 19 May 1964 6 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 27, no. 7, 1963 p 942–944
(FTD-TT-64-297/1+2; AD-601553)

The physical aspect of the phenomenon occurring in a flow-through pickup of nuclear magnetic resonance is considered. A liquid polarized in the magnetic field of a polarizing magnet flows into the coil of the pickup having the vector of magnetization of the nuclei M directed parallel to the outer field H_0 in the pickup. Equations and desirable conditions are given for maximum amplitude. G.D.B.

N64-25544 Los Alamos Scientific Lab., N. Mex.
EXPERIMENTAL STUDIES OF A CROSSED-FIELD PLASMA ACCELERATOR
D. A. Baker and J. E. Hammel 6 Jul. 1964 36 p refs
(Contract W-7405-ENG-36)
(LA-3078)

A linear plasma accelerator based on crossed electric and magnetic fields was studied. Experiments were performed with neutral gas or with plasma from a coaxial gun injected between the parallel-plate electrodes of the device. In both cases the velocity of the emergent plasma stream could not be made to exceed ~ 5 cm/μsec. Attempts to raise the stream velocity by increasing the electrode supply voltage resulted only in the production of a higher density stream traveling at the same limiting value of velocity. The dense ($n > 10^{15}$ cm^{-3}) stream emerging from the electrode region was only slightly diamagnetic, and it moved across the transverse magnetic field by means of an $\vec{E} \times \vec{B}$ drift in which $\vec{E}$ is a polarization electric field produced by charge separation in the plasma. The forward drift of the stream could be stopped by conducting plates located to the side of the stream to drain off the polarization charge. The measurement of the depolarization current yields a new method of determining the stream momentum flow. Author

N64-25589 General Applied Science Labs., Inc., Westbury, N.Y.
BACK-SCATTERING BY A CORRUGATED PLASMA CONFIGURATION—HOMOGENEOUS PLASMA, NORMAL INCIDENCE, LONG CORRUGATION WAVE LENGTH
F. Lane, S. Mariano, and G. Weilerstein 6 Jan. 1964 57 p refs
(Contract NOw-63-0637-C FBM)
(TR-394; AD-430009)

An approximate technique was developed in a previous paper for computing the backscattering from a cylindrical plasma configuration having arbitrarily large (axisymmetric) radial nonuniformity of electron density and slowly varying axial nonuniformity. The method relied upon the use of an axial distribution of multipoles to represent the scattered field. In the present program, the same technique is applied to a plasma configuration whose axial dependence is weak in a geometric sense rather than because of inhomogeneity. A corrugated cylindrical plasma structure, with a long corrugation wavelength (long relative to plasma radius and incident wavelength) and with homogeneous plasma electron density, is subjected to a plane incident wave with the direction of incidence normal to the plasma centerline. This corrugated configuration is an idealization of the wake behind an oscillating vehicle. Because of the assumed long corrugation wavelength, the approximation is justified. This amounts to a sort of strip theory in which an axial distribution of multipoles is assumed, the multipole strength depending upon the local-z plasma

geometry. The geometry or local plasma envelope radius leads to the z-dependence of the multipole density distributions, since the plasma is assumed uniform. I.v.L.

N64-25617 Boeing Scientific Research Labs., Seattle Wash. Plasma Physics Lab.
MEASUREMENTS OF THE INTERNAL MAGNETIC FIELD ASSOCIATED WITH THE SUPERCITICAL OPERATION OF THE POSITIVE COLUMN
Roy R. Johnson Jul. 1963 19 p refs
(DI-82-0283)

The helical instability of the positive column in a longitudinal magnetic field has been observed by measuring the internal magnetic field of the positive column. The measurements were performed in helium with discharge tubes that had radii of 2.35 cm, 3.54 cm, and 4.75 cm, and lengths of 1.37 m. The measurements of the internal magnetic field of the positive column were made as a function of applied magnetic field, gas pressure, and d.c. discharge current. Good agreement was found between these results and the theory of the helical instability of the positive column in a longitudinal magnetic field. Author

N64-25661 Ion Physics Corp., Burlington, Mass.
P-N JUNCTION FORMATION TECHNIQUES Quarterly Technical Progress Report, 2 Jan.–2 Apr. 1964
William J. King Wright-Patterson AFB, Ohio, Aero Propulsion Lab. [1964] 86 p refs
(Contract AF 33(615)-1097)
Rept.-2; AD-438515)

The ion implantation apparatus was finished and tested using a variety of ion sources and feed gas combinations. While a high current source (100μamps) was being developed, a radiofrequency-type ion source was used to obtain a phosphorus beam for cell production. Samples produced with this system were used to conduct extensive investigations on impurity motion, enhanced diffusion, profiles, annealing effects, and leakage mechanisms. Results and conclusions of these investigations were partially tested by fabrication of cells. Cell (N on P) efficiencies varied from 6.2% to 9.3% with equal photon spectral response curves peaking as low as 5,600 A. Plasma deposition studies were conducted using two different deposition sources and vacuum systems. Operation of the larger of these sources was investigated in detail, and a well-controlled deposition mode for silicon was found. Silicon films up to 6μ thick deposited on mica were quite uniform with very high resistivities ~500 megohms^2. Post deposition thermal treatment and diffusion were tried with these films to investigate film quality and junction formation. Author

N64-25693 Raytheon Co., Waltham, Mass. Research Div.
STUDY OF MICROWAVE GENERATION BY MEANS OF ELECTRON BEAM INTERACTION WITH ANISOTROPIC MEDIA Second Quarterly Progress Report, 1 Oct.–31 Dec. 1963
S.F. Paik and R. J. Briggs [1963] 40 p refs
Contract DA-36-039-AMC-02362(E))
Rept.-2, S-612; AD-432033)

The interaction of an electron beam with an annular plasma column is considered. Experimental work to determine the modes of propagation in an annular plasma column is now under way. The electron-beam interaction with modes other than the axially symmetric mode, which might give rise to unwanted "spurious" oscillations, is investigated theoretically. In particular, the interaction between the n = 1 surface-wave mode in an annular plasma column and the cyclotron and synchronous waves is considered. It is shown that the desired interaction between the space-charge wave and the n = 0 surface-wave mode will predominate over the transverse interaction if the ratio ω/ω_c is not excessively large. Also, results of the experimental work on waves in anisotropic resistive material (Pyrographite) are presented. Author

N64-25729 Massachusetts Inst. of Tech., Cambridge Fluid Mechanics Lab.
STRUCTURE OF A PLASMA SHOCK WAVE
Michel Y. Jaffrin and Ronald F. Probstein May 1964 64 p refs
(Contract Nonr-18411(93))
(AD-441795)

The one-dimensional, steady-state structure of a shock wave in a fully ionized plasma is investigated in the absence of externally applied magnetic or electric fields. The structure is assumed to be described by the Navier-Stokes equations written for electron and ion fluids, together with Poisson's equation for the self-induced electric field. When the Debye length downstream of the shock is small compared to the ion-ion mean free path there, the plasma remains essentially neutral and the equations governing the charge separation and electric field can be uncoupled from the system. The remaining equations are reduced by a boundary-layer-type analysis, which uses the fact that different dissipative mechanisms are important over different length scales, and an integration in phase space is carried out. I.v.L.

N64-25735* Maryland U., College Park Inst. for Fluid Dynamics and Applied Mathematics
COMMENTS ON "NONLINEAR LANDAU DAMPING OF OSCILLATIONS IN A BOUNDED PLASMA"
David Montgomery Repr. from the Phys. of Fluids, v. 7, no. 3, Mar. 1964 1 p refs
(Grant NsG-220-62)

The purpose of this note is to call attention to a recent numerical integration of the nonlinear Vlasov equation by G. Knorr and to relate a certain part of it to a perturbation expansion of this equation. The main result was a demonstration that, under mild restrictions on the allowed initial distribution function, the electric field would damp to all orders in the perturbation theory with a rate given by that of the first-order solution. It was also pointed out that, due to an effect first noticed by Backus, there would probably be an upper limit on the time for which the expansion would be valid. I.v.L.

N64-25753 Michigan U., Ann Arbor Electron Physics Lab.
NOISE PROPAGATION IN AN ACCELERATED NONUNIFORM ELECTRON GAS Technical Report No. 70
G. Hok Mar. 1964 36 p refs
(Contract AF 33(657)-8050)
(Rept.-05000-13-T; AD-601947)

Approximate phase-integral solutions of the differential equation for adiabatic propagation of plane compressional waves in an accelerated electron stream are studied. The adiabatic assumption excludes Landau damping, but since the conditions under which Landau damping is to be expected are well understood, this fact is not a serious disadvantage. The approximate solutions are analyzed for stop bands, phase velocities, and conditions favorable to Landau damping. Previously known results are obtained as asymptotic limits. A singularity analogous to a shock wave is found at the plane where the

stream velocity equals the sound velocity in the electron gas. No suggestion of a noise-reducing mechanism beyond this plane is found, indicating that a minimum noise temperature of about 1/6 of the cathode temperature is obtainable, if a total reflection of noise occurs at the shock plane. A three-dimensional pattern of tilted shock waves could reduce the noise temperature below this value. Author

N64-25813 Adelphi Coll., Garden City, N.Y.
SHORT AND LONG WAVELENGTH DISTURBANCES OF A TWO-COMPONENT COLLISIONLESS PLASMA, WITH POLARIZATION PARALLEL TO A UNIFORM MAGNETIC FIELD
James K. Thurber May 1964 71 p refs
(Contract Nonr-3360(01))
(AGM-115; AD-440208)

An asymptotic solution to the plane wave initial value problem is given. A plane wave initial disturbance will not generally remain so, but will decompose into an infinite number of modes for all time after the initial disturbance. For the case considered in this paper, the direction of polarization of the wave is parallel to a uniform magnetic field. A two-component model is studied. The positive charges are carried by one component and the negative charges by the other; the particle collision effect is neglected. The interaction between the gas particles is due solely to the electromagnetic field, which in turn is described by the pre-Maxwell equations. The distribution functions for the two species are described by the Vlasov equations. G.D.B.

N64-25814 Martin Co., Baltimore, Md. Nuclear Div.
RESEARCH PROGRAM ON CLOSED-CYCLE MAGNETO-PLASMADYNAMIC ELECTRICAL POWER GENERATION WITH NON-EQUILIBRIUM IONIZATION Final Technical Report, Jun. 1962 - Mar. 31, 1964
W. J. Levedahl Apr. 1964 122 p refs
(Contract Nonr-3866(00))
(MND-3141; AD-439268)

A closed-cycle loop including compressor, heaters, generator, coolers, and auxiliary equipment capable of operation with cesium-seeded helium, neon, or argon was designed and constructed. After satisfactory checkout of the loop, the low-temperature duct was removed and the high-temperature generator assembly was installed; tests were performed. A theory of magnetically induced nonequilibrium ionization in an MPD generator was also developed. A number of cesium-seeded helium-filled discharge tubes were fabricated and tested. This program was also involved in the study and analysis of closed-cycle MPD power generation; the equations governing the behavior of a conducting gas in the generator were solved for conditions compatible with using nonequilibrium ionization. G.D.B.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-24318 Emerson and Cuming, Inc., Canton, Mass.
DIELECTRIC PROPERTIES; DATA AND MEASUREMENTS TECHNIQUES
Paul E. Rowe, Eino J. Luoma, and Elery F. Buckley *In* AFSC, Griffiss AFB, N.Y. Symp. on Radar Reflectivity Meas. Apr. 1964 p 456–474 refs (See N64-24281 17-15)
(Contract AF 33(616)-7047; AF 33(657)-11139; AF 19(628)-500)

This paper has the dual purpose of reviewing the range of available dielectric properties and of summarizing recent advances in the techniques of measuring dielectric properties. Author

N64-24388 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
LARGE AREA SEMICONDUCTOR SURFACE PASSIVATION PRODUCTION REFINEMENT PROGRAM Interim Engineering Progress Report No. 3, 1 Jan. 1964–31 Mar. 1964
H. C. Evitts, D. Peterson, D. Tolliver, and A. Epstein Apr. 1964 37 p
(Contract AF 33(657)-11268)
(IR-7-879(XII); AD-439885)

The primary process under development for the complete passivation of planar silicon devices has been that of depositing various glass films over the surface. These surface-sealing silicate films are deposited from the vapor phase. The construction of a production plating system capable of large volumes of devices has been completed and tested. Process aging test results are given for a number of different films under development. Additional work in the area of improved packaging is reported. Author

N64-24389 Purdue U., Lafayette, Ind. School of Aeronautical and Engineering Sciences
A DYNAMICAL THEORY OF POLAR DIELECTRICS
Roy C. Dixon and A. Cemal Eringen Apr. 1964 89 p refs
(Contract Nonr-1100(23))
(TR-25; AD-600329)

Basic axioms of the theory of continuous media are employed to obtain the field equations, jump conditions, and constitutive equations of a polar elastic dielectric, subject to large deformations and electromagnetic fields. The theory is dynamical and includes such polar effects as stress moments and electric quadrupole moments. Relativistic effects associated with large material velocities are not incorporated into the theory. Electromechanical interaction forces and their energies are calculated by assuming a distributed Lorentz force on the bound charges within the volume element. The conservation of mass, balance of momenta, conservation of energy, Faraday's, Ampere's and Gauss' laws are then postulated in integral form, from which the field equations and jump conditions are obtained systematically. An equation of entropy production is given that is used to derive a nondissipative constitutive theory. For the dissipative system there is given a properly invariant second-order constitutive theory with its special forms. Author

N64-24672 Royal Inst. of Tech., Stockholm (Sweden)
PLASMA ROSONANCE IN A GERMANIUM ROD
F. Sellberg *In its* Interaction Between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 63-83 refs (See N64-24668 17-09)

The study of cyclotron resonance in semiconductors has yielded much valuable information on their energy-band structure. In order to increase resonance detectability, a high carrier concentration is desirable, but this introduces magnetoplasma resonance effects as the carriers oscillate collectively. Earlier, pure plasma resonance was observed in flat samples of semiconducting material, where it is exhibited in a transition from a highly reflecting to a transmitted state, as the frequency of the incident wave is varied through resonance. Author

N64-24673 Royal Inst. of Tech., Stockholm (Sweden)
MAGNETO-PLASMA RESONANCE
P. Hedvall and F. Lindvall *In its* Interaction between Microwaves and Plasmas in Gas Discharges and Semicond. 31 Jan. 1964 p 84–93 refs (See N64-24668 17-09)

If a metal- or semiconductor-plasma sample is immersed in a d.c. magnetic field, and irradiated by an electromagnetic wave with a frequency much less than the plasma frequency and the gyrofrequency, then the plasma sample will be resonant for certain values of the frequency. These resonances, which are commonly called magneto-plasma resonances, were observed experimentally in both metals and semiconductors. The associated propagating waves in a long semiconductor rod were studied. The resonances observed can generally be divided into (1) the main resonances with different mode number in the direction parallel to the magnetic field, and (2) the secondary, or satellite, resonances, corresponding to different transverse mode number. The main resonances can be fairly well explained by assuming plane waves propagating along the magnetic field lines. The secondary resonances cannot be explained by the plane-wave approximation. To obtain a theory for these, the proper boundary-value problem must be solved. This is done in an approximate manner for circularly cylindrical samples in the theory given. Author

N64-24710 Brookhaven National Lab., Upton, N.Y.
UNIVERSAL SPECTROMETER I
Andrew Kevey Mar. 1964 12 p
(BNL-851(T-337))

The universal spectrometer is a general purpose machine to be used for neutron diffraction experiments. Its versatility allows single-crystal, powder, or polarized beam studies, and it can be converted into a three-crystal machine for inelastic scattering. This report describes both the operational and the design aspects of the instrument. Author

N64-24821* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
VACANCY FORMATION IN GOLD UNDER HIGH PRESSURE
Hubert H. Grimes Washington, NASA, Jul. 1964 13 p refs
(NASA-TN-D-2371) OTS: $0.50

High-purity gold wires were resistively heated and quenched in a pure argon gas environment at pressures up to 6 kilobars. Quench rates of 10^4 to $5 \times 10^{4\circ}$ C per second were obtained by abruptly reducing the heating current. The resistance of both the specimen and an unquenched dummy specimen were measured at −38° C with conventional circuits. The logarithm of the quenched-in resistance decreased linearly with increasing pressure at a constant temperature of 600° C. From these data, a formation volume of 0.52 ± 0.07 atomic volume was derived, which was assumed to be associated with the formation of single vacancies. For atmospheric pressure quenches from below 725° C, Arrhenius plots of the quenched-in resistivity for various quenching temperatures yielded an average formation energy for single vacancies of 0.93 electron volt. Above 725° C, the quenched-in resistivity drops below this line consistent with the complex annealing behavior during the quench observed by others for higher temperature quenches. Author

N64-24865 Minnesota U., Minneapolis Physical Electronics Research Lab.
RESEARCH IN PHYSICS OF ELECTRON EMISSION AND ELECTRON TUBE TECHNOLOGY Interim Report, 16 Oct.–15 Apr. 1964
D. E. Anderson, A. B. Laponsky, and W. T. Peria, ed. Wright-Patterson AFB, Ohio, Electron. Technol. Lab. [1964] 254 p refs
(Contract AF 33(657)-10475)
(IR-3; AD-439716)

Further secondary emission characteristics of Al_2O_3 and MgO dynodes are reported. Studies of thin-film tunnel current diodes and triodes and of hot electron injection into such devices are reported. Several experiments relating to BaO, (BaSr)O, and BaS cathodes are described. Interpretations of the observed low-energy electron diffraction patterns for MgO and CdF_2 are given. Further results of the surface studies of the Ge:Na and C:Na systems are presented. Recent results on bombardment induced desorption of absorbed gases and the motivation for a new experimental tube are presented. Experiments on electron emission from superconductors are described. Author

N64-24881 Oklahoma State U. Research Foundation, Stillwater Solid State Lab.
SYMMETRY ANALYSIS OF THE STRUCTURAL SPACE GROUP D_{4h}^{14}
Bill P. Clark and E. E. Kohnke May 1964 92 p refs
(Contract Nonr-2595(01))
(TR-3; AD-601798)

The crystal system described by the structural space group D_{4h}^{14} has been considered. The first Brillouin zone for this structure has been constructed and analyzed at points of high symmetry. Wave vector groups and character tables for these points have been obtained. The character systems developed may be used for general theoretical band structure calculations applied to materials, such as stannic oxide and rutile, that display this space group. In order to illustrate the results obtained, the symmetry analysis has been utilized in the construction of free-electron wave functions and energy bands along axes of the zone. Author

N64-24897 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, Nov. 1–Nov. 30, 1964
Z. Szepesi and W. A. Thornton 13 Dec. 1963 17 p
(Contract N61339-1440)
(MTER-5; AD-426692)

Generalized equations were derived for the PC-EL basic image intensifier circuit. A program was written in FORTRAN language using these general formulas for the calculation of image intensifier characteristics. Dark currents and nonlinearities of the PC element and power factor of the EL element were considered. Some curves are presented that were drawn from the data obtained from the computer study. Author

N64-24898 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, Jun. 26–Jul. 31, 1963
Z. Szepesi 6 Aug. 1963 6 p ref
(Contract N61339-1440)
(MTER-1; AD-424832)

This report deals with the development of solid-state image intensifier panels. Theoretical considerations are presented regarding the limitations of photoconductive materials. The materials are CdS and CdSe. Results of these calculations indicate that there is no theoretical reason against obtaining a well working sandwich image intensifier panel and that the development of a photoconductive material, with the required characteristics for the low resolution intensifier, is principally possible.

Also, and X-Y recording device was prepared for recording current-voltage characteristics of photoconductive cells at various illumination; the building of the Hall-effect measuring device has been started, and plans for the building of a clean-room have been made. I.v.L.

N64-24899 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Aug. 1–Aug. 31, 1963
Z. Szepesi 13 Sep. 1963 17 p
(Contract N61339-1440)
(MTER-2; AD-424843)

The study of photoconductive materials began with the measurement and calculation of the fundamental semiconductor characteristics of three CdSe photoconductive cells, both in lateral (coplanar) and in sandwich constructions. Data of measurements and calculations for one cell are presented, and the formulas used for the calculations are given. I.v.L.

N64-24900 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, Sep. 1–Sep. 30, 1963
Z. Szepesi and W. A. Thornton 14 Oct. 1963 7 p ref
(Contract N61339-1440)
(MTER-3; AD-424833)

A large difference was found between the characteristics (surface and volume currents) of coplanar and sandwich construction CdSe photoconductive cells. While the coplanar cell has a high dark current and nearly linear current vs voltage relation (ohmic electrodes), the sandwich cell shows linearity only below 10 v and becomes highly superlinear above 50 v when the top electrode is positive. When the top electrode is negative, this superlinearity starts at lower voltages. In both cases (negative top electrode and positive top electrode), the superlinearity becomes evident at lower voltages when the illumination is lower. Hall effect measurements were made. Experiments for eliminating the inhomogeneities on the image intensifier panel were initiated. Work on evaporated electroluminescent films has started. Yellow-emitting films were made, for the first time, from iodine or gallium containing powder phosphors. These films had reasonably good emission for the first trial. I.v.L.

N64-24901 Westinghouse Electric Corp., Elmira, N.Y. Electronic Tube Div.
APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, Oct. 1–Oct. 31, 1963
Z. Szepesi and W. A. Thornton 11 Nov. 1963 19 p
(Contract N61339-1440)
(MTER-4; AD-426871)

A parameter study of the PC-EL circuit has been initiated with the aid of an IBM 1620 digital computer. The equations used in this study are derived, and the computer program (source program) in FORTRAN language is given. Some figures show a part of the resulting calculations. Changes in the preparation of sintered CdSe layers were made, and some improvements in the characteristics were obtained. Some improvements in the preparation of evaporated EL films were made. Author

N64-24917 Nuclear Corp. of America, Phoenix, Ariz. Semcor Solid State Div.
INVESTIGATION AND STUDY OF RARE-EARTH-DOPED SILICON Final Report
Carl R. Betz Apr. 1964 39 p refs
(Contract AF 19(628)-2412)
(AFCRL-64-406; AD-602031)

This report summarizes the work performed toward the objective of producing single silicon crystals doped with rare-earth elements and with uranium. Crystals were grown by various modifications of the Czochralski method, and the apparatus and techniques are described. The properties, principally the resistivity profiles, and details of doping and of growth, are included for each cyrstal that was grown. A summary tabulation lists and identifies all material delivered under the terms of the contract, including sections of crystals, slices and dice cut from each crystal, and complete diodes fabricated from each crystal. Author

N64-24929 Bendix Corp., Davenport, Iowa Pioneer-Central Div.
FREQUENCY TEMPERATURE COMPENSATION TECHNIQUES FOR QUARTZ CRYSTAL OSCILLATORS Quarterly Report, 1 Oct. - 31 Dec. 1963
1 May 1964 75 p Its Publ. no. 3012-64
(Contract DA-36-039-AMC-02282(E))
(QPR-2; AD-600807)

Stray capacitance effects on TCXO design characteristics are discussed. The relationship of TCXO parameters and the effect of various parameters on the temperature compensation characteristics are discussed, and related information is supplied in graphical form. Thermistor–resistor network synthesis techniques are explained, and examples are shown to illustrate the techniques. The Group I experimental TCXO's are described, and the effect of heat sink materials is shown. Author

N64-24940 General Electric Co., Schenectady, N.Y.
RESEARCH ON CdTe Twelfth Quarterly Progress Report, 1 Feb. - 30 Apr. 1964
R. E. Halsted, D. T. F. Marple, and B. Segall [1964] 26 p refs
(Contract AF 33(616)-8264)
(AD-601674)

A discussion of the evidence for analogous emission processes in Group II and Group VI compounds is presented. An effort to obtain reproducible preparation conditions for p-type CdTe is also discussed. G.D.S.

N64-24991* Harshaw Chemical Co., Cleveland, Ohio Crystal Solid State Div.
RESEARCH ON PHOTOVOLTAIC CELLS Quarterly Progress Report, 1 Aug.–31 Oct. 1963
Norman E. Heyerdahl, Roger F. Belt, Donald J. Harvey, and James C. Schaefer Nov. 1963 25 p refs
(Contract AF 33(657)-7916)
(QPR-6; AD-437683)

CdTe and GaAs films of low resistivity were successfully formed by coevaporation on a variety of substrates. This report discusses these CdTe and GaAs thin films, and it is proposed that the total effort of the contract now be exerted upon the preparation of CdTe thin-film solar cells; if this is not feasible, the effort will be switched to GaAs. Three groups of experiments were performed—film preparation, photovoltaic barrier properties, and X-ray studies. GaAs and CdTe films were prepared by coevaporation and doped by simultaneous deposition of dopant vapor. These films exhibited low resistivity but made a high resistance contract with molybdenum. The spatial and temporal variation of substrate temperature was examined with thin-film thermocouples, and tentative results are given. G.D.S.

N64-25030 Massachusetts U., Amherst Polymer Research Inst.
THE KINETICS OF CRYSTALLIZATION OF POLYPROPYLENE FRACTIONS II
E. Meinecke 27 Aug. 1963 34 p refs
(Contract Nonr-3357(01))
(ONR-TR-58; AD-437751)

Isothermal crystallization rate data for polypropylene films are obtained by a rapid scanning X-ray diffraction technique. These are compared with previously obtained data on similar samples of the same polymer by microscopic observation of spherulite nucleation and growth rates. The degree of crystallinity is found to increase more slowly than the weight fraction of the sample filled with spherulites, indicating that all of the crystallization does not occur at the growing spherulite surface. A mechanism for this secondary crystallization process occurring within the spherulite is proposed, in which the spherulite first forms with an initial degree of crystallinity, and the crystallization continues approaching a limiting degree of crystallinity. The kinetic parameters characterizing this secondary process are determined, and their variation with temperature is studied. Author

N64-25036 Rochester U., N.Y. Inst. of Optics
THE CONSTRUCTION OF A HELIUM–NEON VISIBLE LASER
Douglas C. Sinclair [1963] 13 p
(Contract DA-ARO(D)-31-124-G139)
(AD-437650)

This report is intended to describe the constructional details of a helium–neon visible (6.328 A) laser. The description covers the optical, vacuum, and electrical aspects of the construction. The operation of the laser is also described, and a figure included that shows some patterns obtained from the laser. Author

N64-25090 Radio Corp. of America, Princeton, N.J. RCA Labs.
SOLID STATE LASER EXPLORATIONS Interim Engineering Report, Oct. 15, 1963–Jan. 15, 1964
Z. J. Kiss, R. J. Pressley, F. Sterzer, T. Walsh, and J. P. Wittke Wright-Patterson, AFB, Ohio, Aeron. Systems Div., 1 Feb. 1964 49 p refs
(Contract AF 33(615)-1096)
(IER-1; AD-435158)

Studies of the excitation of trivalent rare-earth ion lasers by crosspumping in absorption bands associated with color centers in the host crystal were made using ErOF-CaF_2. These indicate considerable promise for laser action. Hosts presenting a site of noncubic symmetry for the fluorescent ions were also investigated, including $SrCl_2$ and various halofluorides. Such hosts have strong fluorescent transitions of the electric dipole type, and several show strong fluorescence at room temperature. $SrCl_2$, however, shows a strong tendency to cleave under thermal stress. A method of chemically reducing trivalent dysprosium to the divalent state was found and will be exploited in the future. The variation of wavelength and line width with temperature in $CaF_2:Dy^{2+}$ was determined, and this information was applied to several problems concerning laser operation. Frequency shifts of fluorescence and laser output with excitation level were correlated with thermal tuning effects, and threshold measurements with part of the laser crystal shielded were used to gain insight into basic processes. Beam powers of from three to six times normal were obtained by the use of dielectric film reflectors. Lamp efficiencies were also studied, leading to insight into optimum operating conditions. Magnetic effects in $CaF_2:Dy^{2+}$ lasers were studied using various coil configurations. Magnetic modulation is readily obtainable up to 100 kc/sec, and the natural spiking can be synchronized at frequencies well above this, to at least 475 kc/sec. Preliminary laser amplifier studies have been made that indicate gains of greater than 2/in. should be obtainable. Losses at microwave frequencies have been measured in various electro-optic crystals. A variable-bandwidth, cavity-type, microwave-frequency light modulator was designed and is under construction. The detailed theory of the electro-optic effect in tetragonal crystals of the KDP type was worked out for an arbitrary direction of the electric field with respect to the crystal axes. Several semiconductor diode detectors were constructed, having response past the dysprosium laser wavelength at 2.36μ. These detectors have a response (rise and decay) time of less than 20 nanoseconds, and a sensitivity that is only three times less than the comparable commercially available units having a much slower response. Author

N64-25120 Naval Ordnance Test Station, China Lake, Calif.
FLUORESCENCE PUMPING OF LASERS Technical Progress Report 356
Julian L. Thompson Apr. 1964 15 p
(NOTS-TP-3506)

As a part of a continuing program of laser efficiency improvement studies, a preliminary investigation has been made of the feasibility of converting the energy from an essentially white light source into useful pumping wavelengths by means of fluorescence. Both fluorescent dye solutions and powdered phosphors have been considered, and a laser head of coaxial design has been constructed that will enable an experimental study to be made of the use of either, or a combination of both, in modifying the light from an electronic discharge tube. Geometrical design of the optical coupling between lamp and laser rod also comes under study in the search for the ultimate design for the maximum conversion of electrical energy input into coherent light output. Author

N64-25221 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
FIRST AND SECOND NOTES ON DOUBLE REFRACTION ARTIFICIALLY PRODUCED IN REGULAR CRYSTALS
M. G. Wertheim 28 May 1964 10 p Transl. into ENGLISH from Compt. Rend. (Paris), v. 33, 1851 p 576–579 and v. 36, 1852 p 276–278
(RSIC-185; AD-601822)

Results of investigations include the following: (1) Regular crystals cannot be assumed to be optically homogeneous or isotropic bodies. (2) The elastic axes and the optical axes do not always coincide with the axes of mechanical elasticity, and the compressions or tensions in both are not always proportional to the molecular compressions or tensions. (3) The optical properties alone are insufficient to provide information about the direction and magnitude of mechanical compressions that exist in the interior of naturally birefringent crystals. (4) The coefficient of elasticity is constant for every mineral in a regular system. (5) Crystals that have only cubical faces behave like homogeneous bodies, under the influence of external forces. (6) The displacement of optical and mechanical axes occurs as the position of the optical axes were previously drawn in the crystal. (7) The unequal optical compressibility, as well as the rotation of the optical ellipsoid, appears to originate in permanent effects resulting from stresses or compressions that occur during crystallization. (8) Phenomena observed when compression is used to convert regular crystals into negative birefringent crystals are produced in absolutely the same manner when traction is applied to make them into positive crystals. I.v.L.

N64-25320 Colorado State U., Fort Collins.
STUDIES, RESEARCH AND INVESTIGATIONS OF THE OPTICAL PROPERTIES OF THIN FILMS OF METAL SEMICONDUCTORS AND DIELECTRICS Semi-annual Report 16 Feb. - 15 Aug. 1963
Lawrence N. Hadley [1963] 28 p refs
(Contract DA-44-009-ENG-3828)
(SAR-8; AD-439958)

The results of the investigation indicate that the evaporation of refractory metals is possible by means of the exploding wire technique, and that deposition rates of at least 10^6 A/sec can be expected. However, for the technique to be of any real use the macroscopic structure of the resultant films would have to be improved greatly. P.V.E.

N64-25344 General Electric Co., Utica, N.Y. Light Military Electronics Dept.
RADIATIVE INTERCONNECTIONS OF SOLID STATE CIRCUIT ARRAYS Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. R. Barrett, G. E. Claflin, G. C. Gerhard, S. W. Ing, Jr., and H. A. Jensen [1964] 56 p refs
(Contract DA-36-039-AMC-03279(E))
(QPR-3; AD-602086)

The wavelength response of several GaAs p-n emitters was measured at room temperature. The peak response was approximately 9,050A, as expected. The results of measurements of the quantum efficiency of emitters, with use of both the old and new starting materials, are presented. The results of quantum efficiency measurements with application of another measuring technique (integrating sphere) are presented and discussed. Directionality measurements are presented and discussed. Photoconductors in general are discussed; and three basic models are analyzed, and compared with each other and with currently available phototransistors. Elementary design considerations for photoconductors are presented. Currently used photodetector fabrication methods are given, and a new type of detector is shown. Measurements of gain, response time, and noise, on these and older types, are presented. A microcircuit function was selected and micrologic was obtained; the circuit was built, which demonstrated that a radiative interconnection channel can be made to work at room temperature with no special coupling media, and modest gain requirements. A discussion of this and photoconductor-transistor amplifier design considerations are presented. Author

N64-25374 Brandeis V., Waltham, Mass.
PHOTOIONIZATION, ELECTRON-TRAPPING AND PHOTOCONDUCTION IN GLASS Final Report
Henry Linschitz and Richard A. Hebert 2 Apr. 1964 205 p refs
(Contract AF 19(604)-4536)
(AFCRL-64-298; AD-602380)

This report describes an experimental study of photoionization and electron trapping in glassy media, using spectrophotometric and conductimetric techniques. Aromatic anions (mono- and di-negative ions of naphthacene) were selected as the systems for study because of their low ionization potentials, slow back reactions, and known spectra of the ions and parent hydrocarbons. The glassy solvent was 2-methyltetrahydrofuran (2-MTHF) at liquid N_2 temperature. Special handling and photoconductimetric techniques were developed for this system. Using chemical actionometry, quantum yields for the overall photoionization and electron-trapping process were measured for both the mono- and di-negative naphthacene ions in rigid 2-MTHF. A new effect was observed, in which the photothreshold of platinum or stainless-steel electrodes was shifted from below 2,600 A to about 5,000 A, as a result of contact with naphthacene dianion. The electrodes maintain this "sensitized" condition even after thorough washing, and act as electron photoinjectors in contact either with vacuum or with pure solvent. Glasses containing dissolved naphthacene dianion show additional photoconductivity with spectral response paralleling the solute absorption spectrum. At low solute concentrations and with no imposed fields, the cells show a strong photovoltaic effect. The observed phenomena, including effects of intensity, exposure time, photovoltaic behavior, and "reversed" photocurrents. can be consistently interpreted on the basis of simultaneous electrode and volume ionization processes, combined with space-charge effects. These latter complications arise from the differential rates of diffusion of negative and positive carriers, and from finite electron-trapping energies. Author

N64-25488 Aberdeen Proving Ground, Md. Ballistic Research Labs.
A FAST PULSE ELECTRON BEAM SYSTEM
Harold C. Forst, John D. Knapton, and Richard H. Comer Aug. 1963 14 p refs
(BRL-MEMO-1507; AD-423018)

An electron beam system for producing short duration pulses is described. The electron beam is accelerated up to ground potential by a maximum accelerating potential of 60 kv. Pulse duration times of 3 nanosec are theoretically possible, and beam currents up to 125 μamps were measured. Author

N64-25515 Dayton U., Ohio Research Inst.
INVESTIGATION OF LASER BEAM CROSS-SECTION WITH RESPECT TO INTENSITY AND TIME Quarterly Progress Report, 1 Jan.–31 Mar. 1963
Werner Rambauske and Michael K. Barnoski [1963] 49 p
(Contract AF 33(657)-9014)
(QPR-3; AD-602525)

The multimode nature of the laser cavity suggests that the beam consists of discrete, optical components separated by a definite interval $\Delta\lambda$, where λ is the wavelength in A. The photodetectors used to detect this radiation will thus act as photomixers and heterodyne the various modes that, due to the nature of laser cavity emission, already seem to be pulse amplitude modulated. In the course of the investigations it was discovered that no two points in the beam's crosssection displayed the same intensity versus time variation. These results were obtained by utilizing two identical detection systems positioned at various points in the beam's crosssection. Photographic recording of the dual beam scope traces are included in the report. In addition to this, the average intensity over a 50 μsec interval versus lateral distance through the beam was determined, and the results were plotted. A bell-shaped curve was obtained. Author

N64-25567* Rensselaer Polytechnic Inst., Troy, N.Y.
RADIATION DAMAGE - ELECTRON IMPACT Status Report
F. A. White and G. P. Calame Apr. 1964 8 p
OTS: $1.10 ph
(Grant NsG-371)
(NASA-CR-56830)

Theoretical work to date has been confined to an attempt to correlate theoretical studies of proton-induced radiation damage in germanium, over the range of incident proton energies from 20 Mev to 150 Mev. Emphasis was placed on the inclusion of nuclear scattering and on reactions in predictions of damage. The symmetric 20-in. radii of curvature of electrostatic and magnetic analyzers were tested as a double-focusing system, and a coincidence scheme for detecting single ions in a radiation environment was furthered. G.D.B.

N64-25618 Keystone Controls Corp., Newark, N.J.
5 MC SINGLE-SIDEBAND CRYSTALS Second Quarterly Progress Report, 1 Oct. 1963–31 Dec. 1963
Raymond F. Woolley [1963] 35 p
(Contract DA-36-039-AMC-03307(E))
(Rept.-2; AD-438514; SCL-7731)

The report details results of fabrication and indicates problems that have been encountered in maintaining desired angles of orientation through the contouring operation. The "Q" in excess of 500,000 has been achieved with units finished with a 305 abrasive and plated with an evaporated aluminum film. Successful methods of achieving a mechanically strong bond using Du Pont 5504A cement are also reported. Photographs and details of the aging equipment and primary frequency standard comparison system being used in the study are presented, as well as curves of frequency and resistance vs temperature of typical units. Author

N64-25684 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
INJECTION LASER STUDY Third Quarterly Progress Report, 1 Dec. 1963–29 Feb. 1964
W. P. Dumke, G. J. Lasher, F. Stern, and K. Weiser [1964] 77 p refs
(Contract DA-36-039-AMC-02349(E))
(Rept.-3; AD-601034)

The Mn- and Zn-diffused GaAs negative resistance diodes were switched from the low-current state into the high current, lasing state at 4.2° K. Switching times of the order of 10^{-7} sec have been obtained in the rather small range of excess voltages used so far. The current–voltage characteristic of the double diffused diodes changes from a linear to a quadratic dependence as the current increases, as predicted by the theory of Ashley and Milnes. An electron lifetime of $\approx 10^{-8}$ sec in the Mn-doped region is deduced from these results. An alternative to the bistability mechanism for a GaAs laser with two regions, only one of which carries appreciable current, has been proposed. It postulates that the bridge between the two regions acts as a photoconductor and lets the current divide between the two regions, thus lowering the threshold current. A series of results for the gain factor and for the loss in a three-layer model of an injection laser is given. The angular dependence of the far-field emission pattern of the diode is also calculated approximately. A comparison of the properties, preparation, and device applications of InP and GaAs is presented. Author

N64-25755 Cutler-Hammer, Inc., Deer Park, N.Y. Airborne Instruments Lab.
STUDY OF SOLID-STATE AND TRAVELING-WAVE MASER TECHNIQUES Technical Documentary Report
J. A. De Gruyl, W. W. Heinz, S. Okwit, and J. G. Smith Griffiss AFB, N.Y., RADC, Jun. 1964 13 p refs
(Contract AF 30(602)-2989)
(RADC-TDR-64-226; AD-602437)

The purpose of this program is to develop improved maser techniques and apply them to an operable breadboard maser system. Improved techniques for obtaining the required field gradients were developed, and instantaneous bandwidths greater than 300 mc were obtained using them. In addition, the feasibility of obtaining 500-mc instantaneous bandwidths was shown. Author

N64-25791 Brown U., Providence, R.I.
DYNAMICAL DISLOCATION MODELS OF CRYSTAL PLASTICITY
P. P. Gillis Apr. 1964 110 p refs
(Contract Nonr-562(32))
(TR-7)

For glide occurring in a single system, a general relation is established between the rate of plastic strain and the configuration and velocity distribution of dislocations in a monocrystal. An elementary model of mechanical behavior is developed, assuming that the average velocity of dislocations is represented by the quasi-viscous relation $v = v^* \exp[-B/\tau]$, and that the time rate of increase of dislocations is proportional to the number of dislocations and their average velocity. An improved model is derived by additionally assuming a dislocation stalemating rate proportional to the square of the number of dislocations and their average velocity. Neither of these models exhibits strain hardening. Finally, models are proposed that do exhibit strain hardening. The hardening mechanisms considered are: effect of strain on dislocation mobility; the reduction of average velocity caused by spatial fluctuations in the stress field; and stalemating interactions between fixed and mobile dislocations. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-24373 United Research Services, Burlingame, Calif.
PREDICTION MODELS FOR FIRE SPREAD
P. V. Phung and A. B. Willoughby [1964] 19 p Presented at the 1964 Spring Meeting of the Western States Section, The Combustion Inst., Stanford U., April 1964
(WSS/CI Paper-64-1)

The fire spread models presented resulted from a study of the prediction of fire spread beyond the initial area ignited by a nuclear attack. Discussed are fire spread variables, and stochastic and deterministic approaches to fire spread. R.T.K.

N64-24374 Forest Products Lab., Madison, Wis.
AN APPROACH TO THE MATHEMATICAL PREDICTION OF TEMPERATURE RISE WITHIN A SEMI-INFINITE WOOD SLAB SUBJECTED TO HIGH-TEMPERATURE CONDITIONS
Erwin L. Schaffer [1964] 28 p refs Presented at the 1964 Spring Meeting of the Western States Section, Combustion Inst., Stanford U., Apr. 1964
(WSS/CI Paper-64-5)

This paper presents a method to describe mathematically the temperature rise within wood sections subjected to the combustion process. This approach circumvents the complex nature of the basic combustion process by means of two characteristic phenomena noted in the exposure of one face of wood slabs to the ASTM Standard E-119 fire-exposure conditions, namely: (1) that a constant temperature is developed at the base of the transient char zone, and (2) that a constant rate of char penetration occurs for the species investigated. An equation for the description of temperature rise is derived from these phenomena. Thermal diffusivity and thermal conductivity coefficients of the specimens are calculated by means of the derived equation and compared with the coefficients as determined by other well-known equations for low-temperature coefficients of thermal diffusivity and conductivity in wood. Author

N64-24375 Aerojet-General Corp., Azusa, Calif.
STABILITY RATING TECHNIQUES
R. G. Peoples and P. D. Baker [1964] 59 p refs Presented at the 1964 Spring Meeting of the Western States Section, Combustion Inst., Stanford U., Apr. 1964
(WSS/CI Paper-64-11)

A summary of experience with stability rating is presented, along with an outline of other promising techniques. The concept of stability rating is discussed, and the limitations of current techniques are shown. Experimental data are used to illustrate the behavior characteristics of a few pertinent rating techniques, and also, to support theoretical descriptions of other techniques and/or concepts. Author

N64-24376 Technische Hochschule Munchen (W. Germany)
MEASUREMENTS OF IGNITION DELAYS OF HYPERGOLIC LIQUID ROCKET PROPELLANTS
G. Spengler, A. H. Lepie, and J. Bauer [1964] 23 p refs Presented at the 1964 Spring Meeting of the Western States Section Combustion Inst., Stanford U., Apr. 1964
(WSS/CI Paper-64-12)

After a theoretical discussion of hypergol ignition and a description of instrumentation for measuring ignition delays, some of the results obtained using nitric acid and nitrogen tetroxide and their mixtures as oxidizers are presented. The factors investigated include the influence of the following: (1) the inside diameter of the capillary injection tube; (2) the injection velocity and mixing ratio; (3) the gas pressure in the combustion chamber; (4) the temperature of fuel and oxidizer; and (5) the water contents in fuel and oxidizer. In order to investigate the possibility of the hypergolization of fuels that are not self-igniting with nitric acid, the ignition delay of numerous two-component fuel systems was measured as a function of their mixture ratios. Some of the mixtures investigated include furfurylalcohol and primary amines, UDMH and phenylacetylene with nitric acid, soluble metal ions dissolved in the oxidizer or the fuel, and combinations of furfurlalcohol, UDMH, nitric acid, and nitrogen tetroxide. M.P.G.

N64-24377 Maremont Corp., Pasadena, Calif. Research and Development Labs.
AN INTRODUCTION TO A PLASMA THEORY FOR ACOUSTIC COMBUSTION INSTABILITY
Stanley Singer [1964] 9 p refs Presented at the 1964 Spring Meeting of the Western States Section, Combustion Inst., Stanford U., Apr. 1964
(WSS/CI Paper-64-13)

Although current acoustic combustion theory provides valuable information on the net response of the burning system in unstable combustion, it tends to overlook the properties of the actual specific sources of the instabilities. Two possible sources of acoustic oscillations in combustion are suggested: (1) the generation of acoustic frequencies in the turbulent flow of gases; and (2) the flame itself, which can provide acoustic oscillations as a result of its plasma properties. The acoustic radiation emitted by the flame zone depends both on detailed-energy and mass-transport processes feeding the flame and on an interaction with the combustion chamber. Presently, both of these sources are summarized in the concept of acoustic admittance. If other possible acoustic sources are excluded, a model of combustion instability based on the plasma of the flame can be of value. A review of the limited information available on plasma characteristics that can be correlated with combustion phenomena is included. M.P.G.

N64-24378 Ohio State U., Columbus Rocket Research Lab.
FORMATION OF DETONATION WAVES IN COMBUSTIBLE GASEOUS MIXTURES
Loren E. Bollinger [1964] 49 p refs Presented at the 1964 Spring Meeting of Western States Section, Combustion Inst., Stanford U., Apr. 1964
(WSS/CI Paper-64-15)

A review is presented of selected papers and reports that pertain to the formation of detonation waves in combustible gaseous mixtures. During the past decade, extensive progress was made in elucidating the mechanism, and the parameters that influence it, by which a deflagration wave accelerates and forms a stable detonation. Propulsion devices that employ stabilized detonation waves are being studied; thus, it is necessary to learn more about the transition process. Many investigators believe that a better understanding of the process of detonation-wave formation will assist in the explanation and eventual control of combustion instability in rocket engines. Author

N64-24805 Malakar Labs., Inc., High Bridge, N.J.
KINETIC STUDY OF ROCKET EXHAUST GASES Progress Report No. 8, Quarter Ending Apr. 16, 1964
[1964] 9 p
(Contract DA-30-069-ORD-2918)
(Rept.-103-8; AD-437222)

Flame temperatures, obtained by monochromatic photography, at various points in the luminous flames of PPLA 2328 and PPL 2520 propellants are presented. A formula is presented for the determination of the true-temperature. This formula is $1/T = 1/T_{br} + \lambda/C_2 \ 1nE_f$ where T is the true temperature on degrees K, T_{br} is the brightness temperature in degrees K, λ is the wavelength in centimeters, C_2 is Planck's second radiation constant (1.439 cm/deg), and E_f is the flame emissivity. I.v.L.

N64-24910* Consultants and Designers, Inc., Arlington, Va.
EFFECT OF THE UNSETTLED COMBUSTION REGIME AND OF ROCKET SPINNING UPON THE PRINCIPAL VECTOR AND THE PRINCIPAL MOMENT OF REACTIVE FORCES
V. S. Novoselov 26 Apr. 1964 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn Nauk: Mekhan. i Mashinostr. (Moscow), v. 1, 1964 p 101–103
(Contract NAS5-2078)
(NASA-TT-F-8693; ST-GD-10129)

Formulas are given for the computation of moments of reactive and Coriolis forces. They are valid relative to any point of the hard system linked with the combustion chamber. As an example of the use of these formulas, the case of rocket motion with the aid of a liquid-fuel engine is considered. R.T.K.

N64-24968 Aerochem Research Labs., Inc., Princeton, N.J.
NEGATIVE AND SECONDARY ION FORMATION IN LOW-PRESSURE FLAMES
W. J. Miller and H. F. Calcote Jun. 1964 33 p refs
(Contract Nonr-3809(00))
(TP-93; AD-601615)

Mass spectrometry and Langmuir probes were used in a study of secondary positive and negative ion formation in low-pressure flames. Individual positive and negative ion profiles were examined as a function of pressure and flame temperature. Two mechanisms for the secondary positive ion formation were set forth. The first consists of a series of charge exchange reactions involving the primary ion, CHO^+, and stable combustion intermediates: $CHO^+ + CH_2O \rightarrow CH_2OH^+ + CO$, $CHO^+ + CH_3OH \rightarrow CH_3OH_2^+ + CO$, $CHO^+ +$

$CH_3CHO \rightarrow CH_3CHOH^+ + CO$, and $CHO^+ + C_2H_2O \rightarrow C_2H_3O^+ + CO$. In the second mechanism the primary ion undergoes a chain of oxidative degradation reactions, which includes the observed ions as intermediates. Mass spectrometric negative ion profiles indicated the presence of significant quantities of negative ions ions in flames at 1 to 3 torr. Dissociative attachment processes are the most probable formation route, and C_2^- is apparently the first negative formed via $C_2H_2O^* + e \rightarrow C_2^- + H_2O$. Also, the effects of various additives (including N_2, CO_2, CH_3OH, CH_2O, and CH_3CHO) were studied in these flames as well as in a low-pressure atomic diffusion flame. I.v.L.

N64-24974 Frankford Arsenal, Philadelphia, Pa.
PROPELLANT ACTUATED DEVICES Progress Report, Sep.–Oct. 1963
[1963] 74 p
(Rept.-90-1; AD-437564)

The current progress relating to propellant actuated devices for escape systems includes the following: (1) High-temperature tests were conducted on three oxidizers — nitrogen tetroxide, red fuming nitric acid, and chlorine trifluoride. (2) A quantity of sample lengths of the new, mild detonating fuse with a high-temperature vinyl outer jacket was assembled with the old FA end booster caps, and a similar quantity was assembled using the newly designed end booster caps. These samples were used in a test program after exposure to high temperature, low temperature, temperature and humidity cycling, and water immersion. (3) Drawings of the final design assembly of the XM47 ignition element were completed. (4) Twelve firing tests were made with complete rocket catapults. (5) Four each of three time-delay mechanisms (0.1, 1.0, and 15.0 seconds) were completely assembled and tested for proper-function characteristics. (6) Data from the firings conducted with XM90 and XM91 initiators, previously subjected to random vibrations tests, are presented. (7) Design studies were completed on a prototype XM18 gas generator. (8) Firings were conducted with a gas-generator propellant identified as MDB7, lot PA-E 3-39241. (9) The silver-infiltrated tungsten insert, previously fired, was measured, and it appears that this material actually shrinks under firing conditions. (10) Gas-analysis results were obtained for the HES 6573 and Standard Oil P-1 propellants fired previously. I.v.L.

N64-25020* Little (Arthur D.) Inc., Cambridge, Mass.
CRYOGENIC PROPELLANT FEED SYSTEMS FOR ELECTROTHERMAL ENGINES
Washington, NASA, May 1964 287 p refs
(Contract NAS8-2575)
(NASA-CR-60) OTS: $4.00

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5. THE SUPPORT SYSTEM FOR THE HYDROGEN STORAGE VESSEL p 158–174 refs (See N64-25025 17-26)
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7. ESTIMATES OF THE THERMAL RADIATION INCIDENT ON HYDROGEN TANK DURING THE TRANSFER TRAJECTORY p 193–205 refs (See N64-25027 17-26)
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N64-25021* Little (Arthur D.) Inc., Cambridge, Mass.
HYDROGEN FEED SYSTEM
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 4–73 (See N64-25020 17-26)

The high specific impulse attainable by using hydrogen as a propellant in an electrothermal engine is the reason why a hydrogen feed system is highly desirable. This report discusses such a system in terms of the basis for its design, a description of the overall system, the storage vessel, the expulsion system, the metering and control system, and projected system operation. G.D.B.

N64-25022* Little (Arthur D.) Inc., Cambridge, Mass.
AMMONIA FEED SYSTEM
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 74–108 (See N64-25020 17-26)

A thermal arc-jet system using ammonia as a propellant is considered as a competitive alternate to a hydrogen fuel system. Such a system is described in the following categories: mission parameters, overall system description, storage vessel, expulsion system, and metering and control system. G.D.B.

N64-25023* Little (Arthur D.) Inc., Cambridge, Mass.
SIZING OF THE HYDROGEN STORAGE VESSEL
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 109–127 (See N64-25020 17-26)

Described are some of the functional features of the liquid-hydrogen tank for the arc-jet feed system. The tank size and shape are presented, the operating pressure is determined, and the tank launch weight as a function of liquid reserve is discussed. Two systems are considered, one using an internal tank heater only and the other, the alternate system, using a rotary phase-separating heat exchanger. G.D.B.

N64-25024* Little (Arthur D.) Inc., Cambridge, Mass.
MATERIAL SELECTION FOR THE HYDROGEN STORAGE VESSEL
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 128–157 refs (See N64-25020 17-26)

The inner vessel of the hydrogen propellant tank for the arc-jet vehicle must be constructed of a material that has a high strength per unit weight and suitable toughness and ductility at −423° R. Annealed 5Al–2.5Sn titanium alloy with extra-low interstitial content was selected as the material for the liquid-hydrogen tank. Other materials, such as stainless steel and aluminum, were also investigated. G.D.B.

N64-25025* Little (Arthur D.) Inc., Cambridge, Mass.
SUPPORT SYSTEM FOR THE HYDROGEN STORAGE VESSEL
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 158–174 refs (See N64-25020 17-26)

The mechanical support system for the inner hydrogen tank on the arc-jet feed system must support the tank and isolate it thermally from the rest of the structure on the vehicle. The system described in this report was selected as the lightest weight—one which would sustain all the imposed loads and have a heat leak equal to the target heat leak of 7 w. G.D.B.

N64-25026* Little (Arthur D.) Inc., Cambridge, Mass.
THE METEOROID HAZARD TO THE HYDROGEN STORAGE TANK
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 175–192 refs (See N64-25020 17-26)

To estimate the hazard that meteoroids pose to space vehicles, it is necessary to have a description of the flux of meteoroids in space, their velocity and mass distributions, and their composition. This information was surveyed from the literature as a basis for selecting the appropriate hydrogen storage tank; this report discusses meteoroid hazard and the resulting protective measures taken. G.D.B.

N64-25027* Little (Arthur D.) Inc., Cambridge, Mass.
ESTIMATES OF THE THERMAL RADIATION INCIDENT ON HYDROGEN TANK DURING THE TRANSFER TRAJECTOR
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 193–205 refs (See N64-25020 17-26)

A transfer from an initial orbit near the plane of the ecliptic results in minimum thermal input to the hydrogen vessel. The thermal flux to the hydrogen tank from the SNAP-8 powerplant must be limited. Deployment of the powerplant to a location remote from the hydrogen vessel is an effective means for limiting the gamma heating of the tank's contents. G.D.B.

N64-25028* Little (Arthur D.) Inc., Cambridge, Mass.
THERMAL PROTECTION SYSTEM FOR THE LIQUID HYDROGEN STORAGE VESSEL
In its Cryog. Propellant Feed Systems for Electrothermal Engines May 1964 p 206–226 refs (See N64-25020 17-26)

The liquid-hydrogen storage vessel should be thermally isolated to the degree necessary to preserve the propellant without loss from the moment of launch until it reaches its final 24-hr synchronous orbit. This protection system is described in terms of requirements for ground handling, during ascent, and for 48-hr orbit and orbit transfer. G.D.B.

N64-25210 Naval Ordnance Lab., White Oak, Md.
INITIATION OF EXPLOSIVES BY EXPLODING WIRES. PART III: EFFECT OF WIRE DIAMETER ON THE INITIATION OF PETN BY EXPLODING WIRES
Howard S. Leopold May 1964 28 p refs
(NOLTR-64-2; AD-600058)

The effect of wire diameter on the initiation of PETN by exploding platinum wires was investigated. A 1μf capacitor charged to 2,000 v was used as the energy source for exploding the wires. The diameter of the wire can be chosen so as to favor time reproducibility of explosion, reliability of effecting detonation, or vigor of the bridgewire output. The wire with the most vigorous shock output when tested in air is not necessarily the most efficient for effecting detonation when PETN is loaded on the wire. Author

N64-25349 Picatinny Arsenal, Dover, N.J. Feltman Research Labs.
INADEQUACY OF THERMAL INITIATION THEORY IN INTERPRETING RESULTS OF FISSION-FRAGMENT IRRADIATION OF EXPLOSIVES AT ELEVATED TEMPERATURES
James F. Mallay, Henry J. Prask, and Joseph Cerny (CIT, Lawrence Radiation Lab.) June 1964 19 p refs
(PA-TR-3157; AD-442467)

An extreme test of the hot-spot model of explosive initiation as applied to microscale irradiation events should occur when the explosives are irradiated at elevated temperatures. To so test this model, fission-fragment irradiations of four explosives selected for their high reaction rates (RDX, HMX, PETN, and nitroglycerin) were performed at 125° to 215°C. No explosions or signs of thermal decomposition were observed with any of the explosives. Since a detailed analysis of the resulting cylindrical zones of radiation heating and their subsequent behavior with time predicts initiation for these particular explosives, it appears that the hot-spot model is inadequate in describing microscale irradiation phenomena. Author

N64-25353 Aberdeen Proving Ground, Md. Coating and Chemical Lab.
FIELD EVALUATION OF AN EXPERIMENTAL AIR DRY FUEL RESISTANT COATING
Virgil O. Hatch 6 Mar. 1964 16 p refs
(CCL-160; AD-601697) OTS: $0.50

The object of this investigation is to field evaluate an experimental air-dry fuel resistant coating based on phenolic modified butadiene-acrylonitrile copolymer. The coating was applied to the interior of eight 1,200 gallon, 6- × 6-ft, 2 1/2-ton, fuel transporters and was examined every 3 months for periods up to 21 months. There was no evidence of cracking, peeling, or sluffing of the coating when exposed to various fuels. Small corrosion spots due to improper cleaning prior to coating, were easily cleaned and brush coated. These retouched areas have given excellent service to date. The coating was also applied to the interior of a series of 30-gallon and 5-gallon containers by spray and slush, respectively. The containers were filled with various fuel–water mixtures and placed on exterior exposure. Visual inspection after 12 months showed the coating to be in excellent condition. Author

N64-25476 Atlantic Research Corp., Alexandria, Va.
DYNAMIC MECHANICAL PROPERTIES OF SOLID PROPELLANTS Quarterly Technical Summary Report, 1 Dec. 1963–28 Feb. 1964
Apr. 1964 23 p refs
(Contract NOw-61-1054-c; ARPA Order 22-61)
(QTSR-1; AD-437276)

This report includes the following: (1) plots of G''_p and G'_p of the TPH-1001 propellant (a polybutadiene acrylic acid copolymer) as a function of frequency and temperature in which G'' and G' are the imaginary and real components of the complex dynamic shear modulus, subscript p indicates that the values have been reduced for temperature by the ratio T_o/T (i.e., $G''_p = G''T_o/T$), T is the absolute temperature of the test, and T_o is an arbitrary reference temperature; (2) the shift factor curve of the TPH-1001 propellant; (3) the master curves of G''_p and G'_p of the TPH-1001 propellant obtained using the empirically determined shift factor; (4) the shift factor curve of the AEBA-10 propellant (a polyurethane); and (5) the master curves for G''_p and G'_p of the AEBA-10 propellant. Also, sample preparation and conditioning, the relocation of the Fitzgerald apparatus, and the calibration check of transducer I are discussed. I.v.L.

N64-25483 Ashland Oil and Refining Co., Ky.
RECLAMATION OF JP-6 TYPE JET FUELS WHICH BECAME THERMALLY UNSTABLE DURING STORAGE Technical Documentary Report, Jun. 15, 1963–May 15, 1964
Arnold M. Leas Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jun. 1964 123 p refs
(Contract AF 33(657)-11097)
(AFL-TDR-64-74; AD-601984)

The thermal stability of 19 degraded JP-6 type jet fuels was improved to a level in excess of the specification requirement by a filtration treatment. The improved thermal stability of these reclaimed fuels was retained for more than 6 months of ambient temperature storage. The ASTM-CRC

Coker was used to measure thermal stability. The coker ratings could not be correlated quantitatively with the chemical and physical analyses because of the minute quantity of the contaminants. However, with the use of filter media these contaminants were concentrated sufficiently to show some degree of correlation with the coker ratings. Many of the additives present in these military fuels, as well as those considered as possible future additives, were removed in varying degrees by reclamation filtration. The generation of static electricity, filter media life, process economics, and design variables were other parameters that were investigated.

Author

N64-25501 IIT Research Inst., Chicago, Ill.
A STUDY OF THE FUNDAMENTALS OF LIQUID PROPELLANT SENSITIVITY
Ted Erikson 10 Mar. 1964 19 p refs
(Contract AF 04(611)-9566)
(IITRI-C6024-8; AD-602504)

Preliminary sensitivity tests of lead azide samples, with initial temperatures to −170° C, have been performed in the cryogenic shock-tube facility. Detonations were generally identified within 200μsec of the time that incident Mach 2.6 nitrogen shocks were reflected from the surface of the sample. Two characteristic induction periods were noted. The first period can be considered typical. The second period exhibited an increasing light output that stabilizes. Subsequent light output jumps instantaneously and work output follows within 10μsec to 30μsec. An appreciable sensitivity increase was identified with traces of air (oxygen) in the driven gas and lowered initial azide sample temperatures of 200° C; at otherwise constant conditions time delays decreased by factors of 10 and 2, respectively. Author

N64-25550 France Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
SLOSHING OF LIQUIDS IN MISSILES [LE CLAPOTIS DES LIQUIDES DANS LES MISSILES]
Eugene Bonneau 1964 13 p Presented at the Assoc. Tech. Maritime et Aeron., Paris, 11–15 May 1964 In FRENCH
(ONERA-TP-123)

The measurement of forces generated by the sloshing of liquids in missiles was investigated. Measurement tests were conducted on the following: (1) a Plexiglass mockup to compare theory and experience for the case of a liquid with low viscosity (water) and to test the different types of antisloshing devices (fixed dampers and floating dampers); and (2) a large engine to measure displacement forces, velocities, frequencies of excitation, and damping. The results of these measurements are presented. I.v.L.

N64-25555* Astropower, Inc., Newport Beach, Calif.
INVESTIGATION OF INHERENT STABILITY OF COMBUSTION SYSTEMS Fourth Monthly Progress Report, 1 Oct.–31 Oct. 1963
A. E. Gaede, R. S. Pickford, and R. H. Williams Oct. 1963 14 p refs
(Contract NAS8-11016)
(NASA-CR-56933; Rept.-149-M4) OTS: $1.60 ph

Reported is a preliminary study of the transport properties of gases. All the terms of a given equation that contain derivatives of the velocity greater than first degree and first order are negligible due to the magnitude of the Reynolds number, 10^7 to 10^8. The major problem in applying the analyses of the unperturbed system was the evaluation of the velocity derivative from experimental data. G.D.B.

N64-25582 Purdue U., Lafayette, Ind. Jet Propulsion Center
CONTINUOUS MEASUREMENT OF THE BURNING RATES OF SOLID ROCKET PROPELLANTS Interim Report
J. R. Osborn and R. J. Burick Apr. 1964 77 p refs
(Grant AF-AFOSR-207-63)
(JPC-369; I-64-3; AD-601648)

An experimental system for the direct and continuous measurement of solid rocket propellant burning rates has been developed. A sample of solid propellant is bonded to a holder with an attached shaft that moves the propellant sample within a two-dimensional rocket motor. The flat burning surface of the propellant sample recedes normally as a servomechanism moves the propellant in a direction opposite to the receding propellant surface. The servomechanism operates in such a manner that the burning propellant surface is maintained at a fixed position within the rocket motor. Since the burning surface of the propellant remains fixed, the direct measurement of the velocity of the shaft yields the burning rate. The servomechanism incorporates a radioactive isotope feedback transducer system for detecting the position of the burning surface of the propellant sample. The experimentally determined burning rate data for two composite propellant formulations were reproducible and correlated well with published data. Author

N64-25701 Ethyl Corp., Baton Rouge, La.
RESEARCH ON LIGHT METAL FUELS AND OXIDIZER CHEMISTRY Annual Technical Summary Report No. 1
W. E. Becker, D. H. Campbell, and W. B. Kirsch Jun. 1964 26 p refs
(Contract AF 04(611)-9376; ARPA Order 24)
(EC-636; AD-441593)

The synthesis of inorganic derivatives of difluoramine has been explored. The work included investigations of reactions of high surface alkali metals with several $-NF_2$ compounds at low temperatures and reactions of tetramethylammonium amalgam with HNF_2, $ClNF_2$, and N_2F_4. There was no evidence of any new $-NF_2$ compound formation. Some evidence was obtained for a new 1:1 complex, $(CH_3)_4NF{\cdot}HNF_2$. Other reactions investigated dealt with synthesis of $S-NF_2$ and $B-NF_2$ bonds. These structures were never unambiguously identified. Physical chemical investigations of the ionizing properties of HNF_2 and $ClNF_2$ in various solvents are continuing. These gave evidence of ionization of HNF_2 only in aqueous solvents and no evidence for direct ionization of $ClNF_2$. Author

N64-25716 Rocketdyne, Canoga Park, Calif.
DEVELOPMENT OF PROPELLANT UTILIZATION VALVE SWITCH BOX ASSEMBLIES AND RELATED HARDWARE FOR THE ATLAS MA-5 PROPULSION SYSTEM Final Report
16 Apr. 1964 69 p
(Contract AF 04(695)-306)
(R-5585; AD-435877)

Presented are a description and results of the program conducted to design, fabricate, and test the hardware necessary to provide MA-5 propulsion system compatibility with the 400- and 4,500-cps propellant utilization systems. Author

N64-25754 General Applied Science Labs., Inc., Westbury, N.Y.
A SURVEY OF FUELS SUITABLE FOR EXTERNAL COMBUSTION APPLICATIONS
W. Chinitz Jun. 1964 30 p refs

(Contract DA-30-069-AMC-216(Z); ARPA Order 460; Proj. Defender)
(TM-109, AD-442936)

A wide variety of fuels are examined to determine those suitable for an external combustion application in a specified range of flight conditions. The original list of 27 fuels in 5 classes is reduced to 9 that are potentially acceptable. The 5 classes of fuels examined are hydrocarbon and alcohol liquids, hydrocarbon gases, hydronitrogens, pyrophoric fuels, and monopropellants. The nine selected fuels are JP-4, JP-5, acetylene, TEA, TMA, TEB, TBB, pentaborane, and aluminum borohydride. Further considerations regarding ignitability, stability of combustion, and availability and cost indicate that only TEA, TMA, TEB, and mixtures of hydrocarbons with these three pyrophoric fuels may be acceptable. Author

N64-25780 Shell Development Co., Emeryville, Calif.
VAPORIZING AND ENDOTHERMIC FUELS FOR ADVANCED ENGINE APPLICATION Quarterly Progress Report No. 3, Dec. 1963–Feb. 1964
A. C. Nixon et al [1964] 55 p refs
(Contract AF 33(657)-11096)
(S-13911)

Studies leading toward the development of specifications for heat sink fuels for hypersonic aircraft are continuing. Consideration of the effect of design parameters on the conditions under which endothermic reactions can be carried out has led to the conclusion that space velocities of 20 or higher would be necessary due to volume limitations in high-speed aircraft. A preliminary study of the dehydrogenation of propane to propene has been completed at temperatures up to 1,300° F, pressures up to 10 atm, and liquid hourly space velocities up to 50, over a chromia on alumina catalyst. The maximum heat sink achieved was 1,600 Btu/lb of fuel at 1,200° F. Author

N64-25792 California U., Berkeley
STEADY DETONATIONS IN GASEOUS OZONE
R. W. Getzinger, J. Ray Bowen, A. K. Oppenheim, and M. Boudart Charlottesville, Va. U. School of Eng. and Applied Sci. May 1964 41 p refs For Presentation at the Tenth Intern. Symp. on Combustion, Cambridge U., Aug. 1964
(Contract Nonr-3623(00); Proj. Squid)
(UCB-3-P)

The velocity of steady detonation waves in gaseous ozone has been measured over a wide range of conditions—in tubes of diameter between 1 and 25.4 mm, at initial pressures below 80 and 220 torr, and in mixtures containing from 72.5% to 96.6% ozone in oxygen or argon. The experimental velocities, extrapolated to infinite tube diameter, agree within experimental error with those calculated by the classical theory of Chapman and Jouget. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-24235 Ogden Air Materiel Area, Hill AFB, Utah 2705th Airmunitions Wing
SERVICEABILITY TEST FOR ROCKET MOTOR 14-DS-1000, MK 4 MOD 2 & M8 MODELS
George H. Kawanishi Apr. 1964 18 p
(00Y-TR-64-759; AD-436644)

This project was established to determine if the shelf life of the 14-DS-1000 Rocket Motor could be extended by establishing new low temperature limits. Samples ranging in age from 91 months to 116 months were brought in from field storage, inspected, temperature conditioned, and static fired. Motors, conditioned at −30°, −20°, and −10° F produced an after-burning phenomenon. The 14-DS-1000 Rocket Motor M8 and Mk 4 Mod 2 performed satisfactorily at −30° to −10° F during normal burning. It is recommended that the shelf life of this item be extended 10 years with firing temperature limits of −10° to +140° F. Author

N64-24495 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FLIGHTS TO THE MOON AND THE PLANETS
Ondrej Brychta and Ladislav Sehnal *In its* To the Near and Distant Universe 16 Jul. 1963 p 144–184 (N64-24489 17-05)

Various subjects involved in sending space probes to the moon and planets are discussed as follows: (1) principles of rocket engines; (2) solid and liquid propellant rocket motors; (3) rocket guidance and control; (4) computation of trajectories of interplanetary rockets; and (5) photography in space. P.V.E.

N64-24529* National Aeronautics and Space Administration, Washington, D.C.
SOLVING MECHANICAL PROBLEMS IN ION-ENGINE DESIGN
Richard A. Terselic Repr. from Space/Aeronautics, vol. 41 Apr. 1964 9 p
(NASA-RP-200)

The role of design engineering in four ion-rocket research projects is discussed. Considered are the necessity for high contact pressures, a thrust-measuring device, and designing the cylindrical body. Shown is a grid-wire ion accelerator. The load results for six structural housings are tabulated. Author

N64-24856 Radio Corp. of America, Princeton, N.J.
REVIEW OF ELECTRIC PROPULSION
T. Todd Reboul and Stephen H. Fairweather *In* RCA, Camden, N.J., Systems Eng. and Space Technol., [1964] p 26–33 refs (See N64-24851 17-01)

This paper explains the concept of electric propulsion, compares its performance with other means, and reviews the operation of current engines and engine mechanisms. A considerable advance in power and propulsion technology is needed to realize full benefits of electric propulsion. Nevertheless, only electric propulsion will make practical manned interplanetary vehicles. G.D.B.

N64-24911* Arde-Portland, Inc., Paramus, N.J.
A RADIATION COOLED NUCLEAR ROCKET NOZZLE FOR LONG FIRING DURATIONS
Sidney Elkind N.Y., AIAA [1964] 16 p Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contract NAS3-3670)
(AIAA Paper-64-389) AIAA: $0.50 members, $1.00 nonmembers

A feasibility study was made of an uncooled nozzle for a 20-min firing. A 15,000-mw reactor using 1,000 psia hydrogen at 4,500° F was considered. The analysis consisted of the determination of the transient temperature distribution within the proposed nozzle walls. Modes of heat transfer considered were gas convection; internal heat generation due to gamma attenuation; conduction; and radiation to space. Design requirements were met by a shielded composite wall of tungsten, graphite, pyrolytic graphite, and Rene 41. Author

N64-24959 Brookhaven National Lab., Upton, N.Y.
HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW Bimonthly Technical Progress Review, Volume 2, Number 2
Apr. 1964 58 p
(BNL-866(PR-8)) OTS: $1.50

Reviews dealing with the technology of high-temperature liquid metals are included in this selection, comprising such subjects as physical properties, thermodynamics, fluid dynamics, heat transfer, material development and corrosion, instrumentation, component development, system studies, chemical analysis and chemistry, and fabrication techniques.
G.D.B.

N64-25007* Cosmic, Inc., Washington, D.C.
CHARGED COLLOID GENERATING SYSTEM FOR ELECTRIC PROPULSION Final Report
D. Gignoux, H. F. Anton, and J. J. Shea 12 Oct. 1963 79 p refs
(Contract NAS3-2509)
(NASA-CR-54049; Rept.-68) OTS: $7.60 ph

An induction-charged colloid-generating system was operated satisfactorily. The rotating speed varied between 1,000 and 18,000 rpm, the mass flow between 1.5×10^{-6} and 120×10^{-6} kg/sec, and the voltage between 0 and 50,000 v. Mass flow, beam current, voltage, and thrust were measured with sufficient accuracy to make possible direct measurements of the efficiency. An efficiency of 80% was obtained in repeated experiments.
Author

N64-25008* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Electromechanical Div.
ELECTRON BOMBARDMENT ION ENGINE DEVELOPMENT Final Summary Report
A. C. Eckert, A. F. Bond, R. J. Coerdt, and M. W. Mueller Feb. 1964 134 p refs
(Contract NAS3-2522)
(NASA-CR-54082; TRW-ER-5805) OTS: $10.50 ph

Experimental and analytical efforts to develop an electron bombardment ion engine having a slit aperture geometry and using permanent magnets are described. Data on engine performances of several accel–decel extraction system geometries are presented, and the dependence of the source performance on the source geometry is discussed. A cathode development program is described and evidence for the occurrence of cathode sputtering is indicated. The results of extended testing of the developed ion engine system are presented. Extraction system lifetime is predicted.
Author

N64-25009* General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
NUCLEAR RADIATION HEATING IN LIQUID HYDROGEN. VOLUME I: DESCRIPTION AND EXPERIMENT AND DISCUSSION OF RESULTS
W. A. Hehs, B. O. Mc Cauley, G. E. Miller, and D. M. Wheeler 30 Jun. 1964 152 p refs
(Contract NAS3-3324)
(NASA-CR-54078; FZK-186-1) OTS: $11.50 ph

A comprehensive collection of data is given for evaluating methods to calculate the nuclear-radiation energy-deposition rates and the resultant temperature distributions in liquid hydrogen in a pressurized tank. Nuclear measurements provide data to determine heating gradients in the liquid hydrogen and to determine the contributions of neutron interactions and gamma interactions to the total heating rates. Boiloff and self-pressurization measurements determined the total heat input into the cryogenic system. Temperature distributions in the liquid hydrogen were monitored under variable flow conditions: pressurization, flow rate, heating gradient, and heat input.
Author

N64-25177* Electro-Optical Systems, Inc., Pasadena, Calif.
DEVELOPMENT OF AUTOMATIC CONTROL SYSTEMS FOR ELECTRON BOMBARDMENT AND CONTACT ION ENGINES
R. M. Worlock, A. T. Forrester, G. L. Hoyt, S. Lyons, G. W. Purmal, A. M. Schneider, and G. Sohl N.Y., AIAA [1964] 13 p Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contracts NAS3-2516; AF 33(657)-10980)
(AIAA Paper-64-504) AIAA: $0.50 members, $1.00 nonmembers

Integrated systems consisting of an ion engine, a cesium feed system suitable for operation in a zero-g environment, and an automatic control system were built using both surface ionization and electron bombardment engines. The control system performs the following tasks: (1) Upon command, starts up the engine and brings it to a predetermined level of operation. (2) Maintains thrust at a predicted level while controlling other engine parameters according to specified criteria. (3) Upon command shuts down the engine, leaving it without power but ready for restart. Each system is based on two feedback loops, one of which maintains a predetermined thrust level by controlling cesium vapor flow from the feed system to produce the required ion beam current. In the electron bombardment engine system, the second loop maintains a preselected value of neutral efflux (as measured by a neutral cesium detector) by controlling the power to the engine arc chamber. An alternative version controls arc chamber power to maintain a specified arc current-beam current relation. In the contact engine system, the second feedback loop performs an efficiency optimizing function by adjusting ionizer temperature to maintain the operating point at the "knee" of the ionizer temperature versus neutral efflux curve.
Author

N64-25187 Institute for Defense Analyses, Washington, D.C. Research and Engineering Support Div.
GRAIN DESIGN AND THROTTLING OF HYBRID ROCKET MOTORS
F. A. Williams Mar. 1964 23 p refs
(ARPA SD-50)
(P-119; AD-437677)

Reasonably accurate grain-design equations for hybrid rocket motors conforming to the assumptions applicable to oxygen-polymethylmethacrylate systems are derived. Shapes of efficient grains are discussed. The effect of throttling upon the specific impulse of hybrid motors is analyzed theoretically, and it is concluded that typical hybrids can be throttled over thrust ratios of 10 to 100 with only a 10% variation in the theoretical specific impulse.
Author

N64-25350 Aerojet-General Corp., Sacramento, Calif. Solid Rocket Plant
POLARIS POWER PLANT DEVELOPMENT. ADDENDUM, JULY–DECEMBER 1963
Mar. 1964 158 p Prepared For Lockheed Missiles and Space Co.
(Contract NOw-63-0050-c(FBM))
(Rept.-3888-31M-5. Addend.; AD-442761)

A summary is presented of the accomplishments for tasks in the following areas: (1) chamber-tension monitoring; (2) metal-to-insulation bonding systems; (3) rapid-curing bonding systems for internal insulation; (4) metal-to-epoxy bond studies; (5) room-temperature-curing resins for repairing damaged chambers; (6) chamber-repair procedures; and (7) improved corrosion-preventive coatings.

These tasks are concerned with improving the processing techniques for glass-wound Polaris Model A3 chambers. In addition, materials and fabrication development tasks were conducted with the following objectives: (1) to update material and process specifications; (2) to improve processing techniques; and (3) to investigate the behavior of filament-wound structures and composite materials under various stress conditions. I.v.L.

N64-25386 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TESTING AIR-BREATHING ENGINES
V. M. Dorofeyev and V. Ya. Levin 28 Jan. 1964 297 p refs Transl. into ENGLISH of the book "Ispytaniya Vozoushno-reaktivnykh Dvigately" (Moscow), Gos. Naukhn.-Tekhn. Izd. Oborongiz 1961 p 1–220
(FTD-TT-63-233/1+2; AD-436795)

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N64-25387 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FORMS OF TESTING AIR-BREATHING JET ENGINES
In its Testing Air-Breathing Engines, 28 Jan. 1964 p 4–12 See N64-25386 17-27)

Various methods of testing air-breathing jet engines for different purposes are discussed. Three general categories—scientific research testing, experimental testing, and series testing—are presented. Some of the specific tests mentioned are guaranteed service life, flying laboratory, long-run engineering, experimental aircraft, engine destruction, and control. G.D.B.

N64-25393 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ENGINE FLIGHT TESTS
In its Testing Air-Breathing Engines, 28 Jan. 1964 p 259–285 (See N64-25386 17-27)

This is a general review of Soviet engine tests in flight: the aircraft employed; measurements during flights tests; methods of turbojet engine flight testing; testing the gas-dynamic stability of the engine; and other specific tests. G.D.B.

N64-25402 Atlantic Research Corp., Alexandria, Va.
FEASIBILITY DEMONSTRATION OF PYROLYTIC GRAPHITE COATED NOZZLES First Quarterly Progress Report, 1 Feb.–30 Apr. 1964
James D. Batchelor 20 May 1964 47 p
(Contract AF 04(611)-9708)
(QPR-1; AD-601347)

The objective of this program is to demonstrate the feasibility of pyrolytic graphite coatings for use in uncooled solid-propellant rocket nozzles (in a size range of use for practical propulsion units) under very severe operating conditions. In the current work, nozzles of 1.1-inch and 2.3-inch diameter are to be tested with a 6,500° F propellant. Thermal analyses were completed on several nozzle systems typical of those to be used in motor firings. These analyses indicated the adequacy of the designs selected. Design of the 1.1-in.-diam test nozzle was completed. Several pyrolytic graphite-coated throat inserts were prepared. Problems with delamination cracks occurred with those coatings. In the first motor firing test, partial coating failure and subsequent edge spalling combined to cause erosion of the coating at a rate substantially above the predicted capability of the material. Author

N64-25435 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CERTAIN VERY SIMPLE TIMING REGULATORS ENSURING ACCELERATION OF A TJE WITH RESPECT TO REDUCED PARAMETERS
Yu. V. Lyubomudrov *In its* Autom. Control of Aircraft Eng. 3 Dec. 1963 p 76–84 (See N64-25431 17-01)

Formulas for turbojet engine acceleration timing regulators are presented. The simplest formula for such a timing regulator is $y = \int x\,dt$. In this formula, in place of y and x the following engine parameters can be introduced: rpm n, fuel flow Q, air pressure behind the compressor p_2, and acceleration n. Also the parameters of the external conditions, p_1 and T_1, can be introduced. Proper parameter substitutions result in $n^2 = [\int(kp_2+cp_1)dt]^2$, which is the formula for an rpm timing regulator, and $Q = \int(kp_2+cp_1)^2dt$, which is a fuel flow timing regulator. These last two formulas insure the control laws $n_0 = kp_{20}+c$ and $\dot{Q}_0 = (kp_{20}+c)^2$, respectively, which are expressed only in reduced parameters. In these formulas, k is the reduction coefficient. Also, diagrams of the regulators are presented. I.v.L.

N64-25437 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF THE CONTROL DYNAMICS OF A TURBOPROP ENGINE WITH A NEGATIVE-THRUST LIMITER
L. N. Getsov and T. S. Mart'yanova *In its* Autom. Control of Aircraft Eng. 3 Dec. 1963 p 97–113 (See N64-25431 17-01)

A theoretical investigation was conducted of the control dynamics of a standard single-shaft turboprop engine (TPE) with a negative-thrust limiter (NTL). Results indicate the following: (1) An NTL of a TPE, made according to a closed circuit and acting on the fuel feed, should meet very high requirements with respect to its dynamic characteristics. In order to insure stable thrust control with acceptable transients during movement of the engine control lever, the hysteresis in the thrust gage should not exceed ± 0.5%, and the time constant of the servomotor should not be less than 0.2 to 0.3 sec. (2) The results of testing a limiter at $t_H > 0$, where t_H is the outside air temperature, may serve to evaluate the operation of the limiter in flight at negative temperatures in view of the weak dependence of the dynamic characteristics of a TPE on the outside air temperature, given a constant near-zero thrust and landing velocity. I.v.L.

N64-25438 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CERTAIN FEATURES OF PRESSURE JET ATOMIZERS OF GAS-TURBINE ENGINES

A. M. Prakhov *In its* Autom. Control of Aircraft Eng. 3 Dec. 1963 p 114–137 refs (See N64-25431 07-01)

This report, which deals with the analysis of the deceleration of the motion of a fluid in a swirl chamber, includes formulas and equations for determining: (1) the fluid friction stress at the surface of a solid body; (2) the dimensionless form for the angular momentum of a fluid flowing through an atomizer per unit of time; (3) the volumetric flow of the fluid through the atomizer; (4) the explicit form for the angular momentum of a fluid flowing through an atomizer per unit of time; and (5) the structural relations of the swirl chamber that can lead to a significant deceleration of fluid motion in the chamber. Also, the deceleration of the fluid in the atomizer nozzle is determined, and structural elements are singled out that, in the first approximation, permit the rapid evaluation of the design of an atomizer relative to the fluid deceleration occurring in it. I.v.L.

N64-25453 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE THEORY OF ROCKET ENGINES

V. Ye. Alemasov 20 Mar. 1964 618 p refs Transl. into ENGLISH from the book "Teoriya Raketnykh Dvigateley" Moscow, Gos. Nauchno-Tekhn. Izd., Oborongiz, 1962 p 1–476

(FTD-TT-63-454/1+2; AD-601547)

This is a Russian college textbook on the general theory and design of thermal rocket engines of various kinds. A general description of rocket engines is given. The basic chamber and engine parameters are discussed. Described are the thermodynamics of the processes in the chamber, including the influence of various factors on thermodynamic characteristics. The operating cycles and characteristics are examined for liquid rocket engines, as well as for solid-propellant rocket engines. G.D.B.

N64-25570* Boeing Co., Seattle, Wash. Aero-Space Div.

AIR AUGMENTED ROCKET POWER PLANT DESIGN PROGRAM (PLUMED MIX-MASTER)

Larry E. Savage and Esko G. Cate 10 Jul. 1964 357 p refs (Contract NAS8-11017)

(NASA-CR-56832; AS-1927) OTS: $21.00 ph

The Air Augmented Rocket Power Plant Design Program calculates the thrust (as a function of downstream distance) obtained by enclosing a rocket exhaust within a duct. Additional values calculated are the velocity vector, temperature, density, the species concentrations of H_2O, H_2, O_2, CO_2, CO, and N_2, and the Mach number throughout the mixing region of the exhaust as a function of downstream distance. Author

N64-25571* Lockheed Missiles and Space Co., Sunnyvale, Calif. Nuclear Space Programs

PROGRESS OF RIFT MANUFACTURING PLAN. VOLUME I: MANUFACTURING OPERATIONS

11 Oct. 1963 26 p Presented at the Third Rift Mfg. Eng. Working Group Meeting

(Contract NAS8-5600)

(NASA-CR-56833; NSP-63-106) OTS: $2.60 ph

Progress is reported in the operations of the RIFT manufacturing plan. This volume is considered as the basic plan, and was written to acquaint personnel with the overall Saturn nuclear stage program and its implementation by fabrication, assembly, tooling, handling, and testing. The design of the LH_2 tank is discussed in some detail; its final assembly sequence is illustrated. A section is devoted to the integration of structural engineering development with the manufacturing welding process. G.D.B.

N64-25642* Hughes Research Labs., Malibu, Calif.

DESIGN AND PERFORMANCE OF ION ENGINE SYSTEMS FOR CONTROL OF EARTH SATELLITES

G. A. Work, J. H. Molitor, M. H. Kaplan, and C. R. Collett N.Y., AIAA [1964] 62 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C. 29 Jun. – 2 Jul. 1964

(Contract NAS3-2510)

(AIAA Paper-64-501) AIAA: $0.50 members, $1.00 nonmembers.

The high specific impulse engine is strongly competitive with chemical rockets for applications such as the attitude control and station keeping of synchronous satellites. The ion propulsion control system offers advantages over the other contemporary control systems, both in total system weight and in precision control. These advantages extend to other satellite control applications, such as orbit maintenance for nonsynchronous medium altitude satellites and manned space stations. For most satellite control applications, the power required to operate the ion engines is less than a few kilowatts and can be supplied by solar cells. G.D.B.

N64-25741 Franklin Inst., Philadelphia, Pa. Labs. for Research and Development

TECHNIQUES FOR DETERMINING INFLIGHT THRUST Final Report

Jack J. Shrager and Gunther Cohn (FAA) Jan. 1963 34 p refs

(Contract FAA/BRD-285)

(F-A2495-8)

Methods of measuring the thrust of jet engines were surveyed to determine the state-of-the-art of such measurements and their possible useful application as engine parameters for cockpit presentation. Some other systems for indicating engine performance were also considered but were not studied in detail because of their limitations. An analysis of the theory underlying some of the thrust measuring systems was made to determine if there were any inherent errors. Author

N64-25774* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

MEASUREMENT OF THE HIGH-FREQUENCY PRESSURE PHENOMENA ASSOCIATED WITH ROCKET MOTORS

Steve Rogero 11 May 1964 34 p refs

(Contract NAS7-100)

(NASA-CR-56973; JPL-TR-32-624) OTS: $3.60 ph

An examination is presented of the factors affecting the fidelity of high-frequency pressure measurements made on rocket motors, along with information gained from laboratory and operational evaluations of system components. The principal areas of discussion include techniques for the dynamic testing of pressure transducers, results of shock tube tests on commercially available pressure transducers, the effects of vibration and temperature on the output of transducers, methods for shock-mounting flush diaphragm pressure transducers, techniques for calculating or measuring the frequency response of transmission lines, the effects of line length and/or conditioning equipment on overall system response, the capabilities and limitations of record/playback equipment in use at the Jet Propulsion Laboratory Edwards Test Station and results of rocket motor tests as applicable to overall transducer system evaluation. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-24422* National Aeronautics and Space Administration, Washington, D.C.
COSMIC RAYS
S. N. Vernov and L. I. Dorman, ed. Jun. 1964 394 p refs Transl. into ENGLISH of "Kosmicheskiye Luchi" IGY Program, Section VII, no. 4, Moscow, Izd. Akad. Nauk SSSR, 1961 (NASA-TT-F-127) OTS: $5.00

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23. THE NATURE OF DISTURBANCES IN THE DIURNAL VARIATION OF COSMIC RAYS APPROACHING THE EARTH FROM DIFFERENT DIRECTIONS DURING MAGNETIC STORMS L. I. Dorman and O. I. Inozemtseva p 364–382 refs (See N64-24445 17-28)

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N64-24423* National Aeronautics and Space Administration, Washington, D.C.
NATURE OF THE INCREASE IN COSMIC-RAY INTENSITY AT A FORBUSH-EFFECT MINIMUM
L. I. Dorman, Ya. L. Blokh, and N. S. Kaminer *In its* Cosmic Rays Jun. 1964 p 2–23 refs (See N64-24422 17-28) OTS: $5.00

The following are discussed: (1) expected relative changes in cosmic-ray intensity at different latitudes with change in geomagnetic cutoff; (2) calculations, using coupling coefficients, of the expected increase effect due to a decrease in geomagnetic cutoff for magnetic storms with different ΔH; (3) increase in the intensity of cosmic rays on 13 September 1957; and (4) increase in cosmic-ray intensity on 11 February 1958. R.T.K.

N64-24424* National Aeronautics and Space Administration, Washington, D.C.
ENERGY CHARACTERISTICS OF COSMIC-RAY VARIATIONS DURING MAGNETIC DISTURBANCES
A. I. Kuz'min, A. A. Danilov, G. F. Krymskiy, and G. V. Skripin *In its* Cosmic Rays Jun. 1964 p 24–40 refs (See N64-24423 17-28) OTS: $5.00

Effective magnetic-storm days were taken as the disturbed periods. Two-hour values of cosmic-ray intensity during each magnetic storm were given in the form of graphs. Thirteen cases of appreciable cosmic-ray intensity drops associated with magnetic storms were chosen from observations over a 2-year period (1958–1959). The storms were divided into two classes. The first contains storms with a sudden intensity decrease, for which the decrease time is five or more times shorter than the recovery time; the second, storms with long decrease time. The results of analysis of these storms are presented and discussed. R.T.K.

N64-24425* National Aeronautics and Space Administration, Washington, D.C.
ON COSMIC-RAY EFFECTS—THE FORERUNNERS OF MAGNETIC STORMS
Ya. L. Blokh, N. S. Kaminer, and L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 41–47 refs (See N64-24422 17-28) OTS: $5.00

An investigation was made of the complex action of the magnetized front of a corpuscular stream on cosmic rays by studying the effects that may be detected prior to the onset of a magnetic storm. Experimental data on magnetic storms from a worldwide network of stations are presented. The properties of the stream front and the shock wave were evaluated. R.T.K.

N64-24426* National Aeronautics and Space Administration, Washington, D.C.
ON THE EMISSION TIME AND ANGULAR WIDTH OF SOLAR CORPUSCULAR STREAMS
N. S. Kaminer, Ya. L. Blokh, and L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 48–51 refs (See N64-24422 17-28) OTS: $5.00

The angular width of solar corpuscular streams from the duration of Forbush effects was determined, and the emission time of corpuscular streams was investigated. The data on cosmic rays indicates that corpuscular streams are generally propagated radially from the sun and their angular width is approximately equal to the angular width of the active regions producing the streams. Experimental evidence indicates that corpuscular streams are emitted continuously over a long period of time. R.T.K.

N64-24427* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF VARIATIONS OF COSMIC-RAY INTENSITY, THE EARTH'S MAGNETIC FIELD, AND AURORAS DURING THE MAGNETIC STORM OF 25 MARCH 1958
Ye. V. Kolomeyets, G. A. Sergeyeva, and K. F. Tarasova *In its* Cosmic Rays Jun. 1964 p 52–72 refs (See N64-24422 17-28) OTS: $5.00

The experimental data indicate that the decrease in cosmic-ray intensity occurring during a magnetic storm commences at all stations simultaneously. The magnetic storm effect is observed to depend upon geomagnetic latitude; this is clearly expressed for the neutron component, and feebly expressed for the hard component. No variation in the effect with geomagnetic longitude is observed. The energy spectrum for the primary variation takes the form $\delta D(\epsilon)/D(\epsilon) \approx \epsilon^{-1}$. An increase in the strength of the earth's magnetic field, in the intensity of cosmic radiation and in auroral brightness, is observed at precisely the same time, 2.5 to 3 hours prior to a sharp drop in cosmic-ray intensity. Author

N64-24428* National Aeronautics and Space Administration, Washington, D.C.
THE PROBLEM OF THE NATURE OF THE PREDECREASES OF COSMIC-RAY INTENSITY PRIOR TO MAGNETIC STORMS
L. I. Dorman, N. S. Kaminer, and Ya. L. Blokh *In its* Cosmic Rays Jun. 1964 p 73–88 refs (See N64-24422 17-28) OTS: $5.00

Discussed are the relationship between the nature of corpuscular-stream propagation in the interplanetary medium and geomagnetic disturbances and cosmic-ray variations, the intensification of the interplanetary magnetic field beyond the shock-wave front and the effect on cosmic rays and the averaging of observational data from a worldwide network of stations and discussion of results—properties of the interplanetary magnetic field. R.T.K.

N64-24429* National Aeronautics and Space Administration, Washington, D.C.
THE MAGNETIC STORM IN MID-MAY 1959 AND THE VARIATIONS OF COSMIC RAYS
N. S. Kaminer, L. I. Dorman, and Ya. L. Blokh *In its* Cosmic Rays Jun. 1964 p 89–131 refs (See N64-24422 17-28) OTS: $5.00

Data from Soviet cosmic-ray stations, as well as data from a worldwide network of stations are used to study phenomena associated with the chromospheric flare of 10 May 1959 and observed in the geomagnetic field, in the upper layers of the earth's atmosphere, and in cosmic rays. Included are studies of the increase in the intensity of soft cosmic-ray components of solar origin in the stratosphere and Forbush-type decrease for higher-energy particles, increase effect prior to the magnetic storm, and nonsimultaneity of the onset of the Forbush effect. R.T.K.

N64-24430* National Aeronautics and Space Administration, Washington, D.C.
THE SUPERPOSITION OF FORBUSH EFFECTS IN JULY 1959
Ya. L. Blokh, L. I. Dorman, and N. S. Kaminer *In its* Cosmic Rays Jun. 1964 p 132–150 refs (See N64-24422 17-28) OTS: $5.00

To analyze the complex cosmic-ray phenomena observed in July 1959, use was made of data from registration of the neutron and hard components by a worldwide system of stations. The phenomenon investigated was a rare case of three superposed Forbush effects. This phenomenon was accounted for by the successive penetration of one corpuscular stream with a frozen-in magnetic field into another stream. R.T.K.

N64-24431* National Aeronautics and Space Administration, Washington, D.C.
THE PROBLEM OF THE EFFECT ON COSMIC RAYS OF A SOLAR CORPUSCULAR STREAM IN THE FORM OF A MAGNETIZED ENVELOPE
L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 151–198 refs (See N64-24422 17-28) OTS: $5.00

The role of the individual factors in relation to the cosmic-ray variations due to a magnetized envelope were evaluated. These included factors such as (1) absorption of cosmic-ray particles by the sun; (2) change in their intensity as a result of expansion of the envelope; (3) tendency to balance the particle density inside and outside the magnetic envelope as a result of particle exchange through the envelope surface; (4) nonuniformity of particle fluxes, directed out from and into

the envelope; and (5) change in the reflecting properties of the magnetic cloud with increasing expansion. By solving the differential equation of particle balance, allowing for the combined effect of these factors, the energy spectrum of variations was found for envelopes in the form of a sphere and a spherical sector. A general solution was found for an envelope of arbitrary shape and for an incompletely closed envelope. Also, numerical results were given for various values of the velocity and size of the envelope according to various theories on the properties of the envelope. A comparison with experimental data of the worldwide network of cosmic-ray stations will make it possible to estimate the parameters of magnetic envelopes. Author

N64-24432* National Aeronautics and Space Administration, Washington, D.C.
THE EARTH AS A COSMIC-RAY ABSORBER AND ITS ROLE IN THE CREATION OF FORBUSH-TYPE EFFECTS AND 27-DAY AND 11-YEAR VARIATIONS
L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 199–207 refs (See N64-24422 17-28) OTS: $5.00

The cosmic-ray intensity in a diffusion medium in the presence of an absorber was investigated. The amplitude of the intensity decrease is larger, the smaller the scattering path. The amplitude of the effect rapidly decreases with increasing distance from the earth's surface. Calculations are presented that show the dependence of the scattering path on particle energy, and the effect of bounded clouds with permeable and impermeable boundaries, on the scattering path. R.T.K.

N64-24433* National Aeronautics and Space Administration, Washington, D.C.
ON THE COSMIC-RAY VARIATIONS CAUSED BY AN EXPANDING TURBULENT MAGNETIZED CLOUD
L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 208–212 refs (See N64-24422 17-28) OTS: $5.00

The cosmic-ray variations are considered that may be caused on earth by an expanding turbulent cloud moving in a direction away from the sun for the case when the earth is inside the cloud. To simplify the calculations a spherically symmetrical pattern is assumed—an expanding cloud emitted over the full angle of 4π steradians with the sun as center. R.T.K.

N64-24434* National Aeronautics and Space Administration, Washington, D.C.
STUDY OF THE EFFECT OF SMALL SOLAR FLARES ON THE INTENSITY OF THE NEUTRON COMPONENT OF COSMIC RAYS
Ye. V. Kolomeyets and G. A. Sergeyeva *In its* Cosmic Rays Jun. 1964 p 213–222 refs (See N64-24422 17-28) OTS: $5.00

Analysis of the results shows that, during "small" flares, the sun emits a stream of nucleons with energies satisfying $a\delta D = a\epsilon^{-5.1}$ spectrum with an upper limit of 14 Bev. Considering that a flare effect in the intensity of the cosmic-ray neutron component occurs when the detector is located both inside and outside the impact zones, and that at high-latitude stations the effect is observed at nighttime, it is concluded that Firor's calculations for particle incidence at a given point on the earth, made on the basis of Störmer's theory of forbidden particle energies, are not in complete agreement with the facts, particularly at high latitudes. Author

N64-24436* National Aeronautics and Space Administration, Washington, D.C.
THE COSMIC-RAY BURST OF 4 MAY 1960
N. S. Kaminer, Ya. L. Blokh, and L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 235–266 refs (See N64-24422 17-28) OTS: $5.00

The following are discussed: (1) the solar and geophysical events accompanying the burst of 4 May 1960, (2) incidence zones for particles with various energies, (3) the nature of the global distribution observed for the cosmic-ray burst effect, and (4) the nature of variation in solar-particle intensity with time and the structure of the interplanetary medium. R.T.K.

N64-24437* National Aeronautics and Space Administration, Washington, D.C.
SUDDEN INCREASES IN COSMIC-RAY INTENSITY CONNECTED WITH CORPUSCULAR STREAMS AND WITH ELECTROMAGNETIC CONDITIONS IN INTERPLANETARY SPACE AND IN THE VICINITY OF THE EARTH
L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 267–273 refs (See N64-24422 17-28) OTS: $5.00

An analysis is presented of the increases in cosmic-ray intensity, connected with chromospheric flares. The electromagnetic properties of plasma ejected from the sun are listed. Two possible paths of propagation of solar particles toward earth, and the burst of low-energy solar particles in the stratosphere between 11 May and 13 May 1959 (and the properties of the magnetic trap created) are discussed. R.T.K.

N64-24438* National Aeronautics and Space Administration, Washington, D.C.
ON THE 27-DAY VARIATIONS OF COSMIC RAYS IN THE STRATOSPHERE DURING THE PERIOD BETWEEN JULY 1957 AND FEBRUARY 1958
A. N. Charakhch'yan, V. F. Tulinov, and T. N. Charakhch'yan *In its* Cosmic Rays Jun. 1964 p 274–280 refs (See N64-24422 17-28) OTS: $5.00

Systematic measurements of atmospheric cosmic-ray intensity, carried out with the aid of gas-discharge counters, made it possible to establish the existence of 27-day variations of cosmic rays in the stratosphere. Further measurements showed that these 27-day variations were stable approximately from July 1957 to February 1958. The results of these measurements were studied, and a comparison with solar and geomagnetic data was made. A detailed discussion of the results of measurements made between 1 July 1957 and 1 July 1958 is presented. R.T.K.

N64-24439* National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF THE 27-DAY VARIATIONS OF COSMIC RAYS ACCORDING TO DATA FROM THE WORLD-WIDE NETWORK OF IGY STATIONS FOR THE PERIOD JULY TO DECEMBER 1957
L. I. Dorman and L. Kh. Shatashvili *In its* Cosmic Rays Jun. 1964 p 281–311 refs (See N64-24422 17-28) OTS: $5.00

An investigation was made of the 27-day variations of cosmic rays during a 6-month period of the IGY between 1 July and 31 December 1957. The data were gathered by a worldwide network of stations and are mainly neutron-monitor data. Data are presented on the 27-day variations of low-energy and high-energy cosmic rays, based on stratospheric and underground observations, respectively. Data on magnetic and solar activity are included. R.T.K.

N64-24440* National Aeronautics and Space Administration, Washington, D.C.
27-DAY RECURRENCE TENDENCY IN HARD-COMPONENT INTENSITY DURING A SOLAR-ACTIVITY MINIMUM ACCORDING TO OBSERVATIONS IN TBILISI
A. M. Chketiya and L. Kh. Shatashvili *In its* Cosmic Rays Jun. 1964 p 312–314 refs (See N64-24422 17-28) OTS: $5.00

It has been observed that during a sunspot minimum, the 27-day recurrence in cosmic-ray intensity either disappears or exists in an extremely faint form. This phenomenon was investigated by using data from observations in Tbilisi that covered the entire 1954 period. R.T.K.

N64-24441* National Aeronautics and Space Administration, Washington, D.C.
ON COSMIC-RAY VARIATIONS DUE TO AN ASYMMETRIC SOLAR WIND
L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 315–320 refs (See N64-24422 17-28) OTS: $5.00

The surface of the sun is far from uniform with respect to the distribution of active formations upon it. It is therefore hypothesized that the solar wind generated by active formations will also be far from symmetric, and a model is developed that accounts for this asymmetry and its effects on earth. R.T.K.

N64-24442* National Aeronautics and Space Administration, Washington, D.C.
EXPERIMENTS WITH CROSSED TELESCOPES AND THE NATURE OF THE SOLAR DIURNAL VARIATION OF COSMIC RAYS DURING A SOLAR MAXIMUM AND A SOLAR MINIMUM
L. I. Dorman and O. I. Inozemtseva *In its* Cosmic Rays Jun. 1964 p 321–345 refs (See N64-24422 17-28) OTS: $5.00

Investigations were made of the properties of sources of cosmic-ray diurnal variation. A discussion is presented of the possible nature of the sources, and attempts were made to verify the sources by neutron-component data. R.T.K.

N64-24443* National Aeronautics and Space Administration, Washington, D.C.
THE QUESTION OF THE SIDEREAL DIURNAL EFFECT IN COSMIC RAYS DURING 1954
Ye. S. Glokova *In its* Cosmic Rays Jun. 1964 p 346–351 refs (See N64-24422 17-28)

Apparent sidereal vectors are presented for each year between 1937 and 1958 for Huancayo, Cheltenham, Christchurch, Moscow, and Yakutsk. Supplementary sidereal effects remaining after deducting the mean vectors in 1954 are presented for these same stations. The data indicate that at Huancayo, Cheltenham, and Christchurch, the supplementary sidereal effect completely disappeared during 1955, while at Moscow and Yakutsk, it was still clearly expressed. The geographic distribution of the sidereal effect is complicated and warrants further study. R.T.K.

N64-24444* National Aeronautics and Space Administration, Washington, D.C.
CERTAIN PROPERTIES OF THE SOLAR DIURNAL VARIATION (FROM MATERIAL ON DIRECTIONAL MEASUREMENTS OF COSMIC RAYS BELOW GROUND)
G. V. Skripin *In its* Cosmic Rays Jun. 1964 p 352–363 refs (See N64-24422 17-28) OTS: $5.00

A discussion is presented of the results of directional measurements of cosmic-ray diurnal variation at a depth of 60 mwe that was begun at Yakutsk in September 1954, using counter telescopes directed vertically and at angles of 30° to the zenith toward the north and south; they were continued until January 1956. In july 1956, after alterations of the underground laboratory were completed, these measurements were resumed. In January 1956, surface intensity measurements were begun, using the same telescopes as below ground. In January 1958, two additional similar underground installations began recording at depths of 7 and 20 mwe. Two vertical telescopes were put into operation at the 60-mwe level, in addition to the existing installation. R.T.K.

N64-24445* National Aeronautics and Space Administration, Washington, D.C.
THE NATURE OF DISTURBANCES IN THE DIURNAL VARIATION OF COSMIC RAYS APPROACHING EARTH FROM DIFFERENT DIRECTIONS DURING MAGNETIC STORMS
L. I. Dorman and O. I. Inozemtseva *In its* Cosmic Rays Jun. 1964 p 364–382 refs (See N64-24422 17-28) OTS: $5.00

The relationship between the diurnal variation of cosmic rays and the direction of approach of the primary particles during geomagnetic disturbances was investigated. The method of superposed epochs and elimination of spurious diurnal variations was used. To determine the first harmonic of the diurnal variation, the data from Moscow and Capetown, as well as the data from three groups of neutron-component stations were subjected to harmonic analysis after correction for noncyclic effects. A discussion and analysis of the data are presented. R.T.K.

N64-24446* National Aeronautics and Space Administration, Washington, D.C.
THE PROBLEM OF THE NATURE OF THE SOURCE OF THE DIURNAL VARIATION OF COSMIC RAYS FROM THE DIRECTION OF THE SUN
L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 383–386 (See N64-24422 17-28) OTS: $5.00

Independently of the structure of the magnetic field frozen into a stream, cosmic-ray particles penetrating inside the stream, under the action of an arbitrarily directed magnetic field of any type (regular or turbulent) and the correponding induced electric field, will drift at the velocity of the stream plasma in a radial direction from the sun. A cosmic-ray anisotropy will be observed on earth, the same anisotropy that would be observed if the earth were traveling at a given velocity in the direction of the sun in a space filled with an isotropic stream of particles. The mathematical basis for the foregoing, as for the variation in cosmic-ray intensity, is presented. R.T.K.

N64-24447* National Aeronautics and Space Administration, Washington, D.C.
THE NATURE OF THE LUNAR DIURNAL VARIATION OF COSMIC RAYS
L. I. Dorman *In its* Cosmic Rays Jun. 1964 p 383–386 (See (See N64-24422 17-28) OTS: $5.00

A variation of cosmic-ray intensity with a period of one lunar day and an amplitude of 0.1% to 0.2% was observed. Whether or not this variation is associated with the direct or indirect action of the moon on cosmic rays is discussed, and an attempt is made to clarify the nature of the variation. R.T.K.

N64-24783 Joint Publications Research Service, Washington, D.C.
POLARIZATION OF THE RADIATION OF NEBULAE
E. Ye. Khachikyan *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 327–367 refs (See N64-24759 17-29) OTS: $5.00

It is known that on being reflected, light is polarized. If the assumption that the light of the star is reflected by the nebula is true, then the radiation of the nebula should be polarized. This is discussed for the Crab nebula, the cometary nebulae, and the reflection nebulae. G.D.B.

N64-24796* National Aeronautics and Space Administration, Washington, D.C.
THE RATIO OF SCATTERED AND TOTAL RADIATION TO THE DIRECT SOLAR RADIATION FOR THE ULTRAVIOLET AND VISIBLE PARTS OF THE SPECTRUM
G. G. Sakunov and Yu. D. Yanishevskiy *In its* Actinometry, Atmospheric Optics, and Nuclear Meteorol. p 103–113 refs (See N64-24786 17-21) OTS: $2.75

The results of spectrophotometry of the solar and sky radiation are presented in the form of ratios of the monochromatic radiation of sun, sky, and sun plus sky. These measurements were designed to yield spectral data in relation to meteorological and geographical factors. G.D.B.

N64-24877 Minnesota U., Minneapolis
THE RELATIVE ABUNDANCES OF ENERGETIC HYDROGEN ISOTOPES PRODUCED IN SOLAR FLARES
C. J. Waddington and P. S. Freier Jun. 1964 19 p refs
(Contract Nonr-710(60))
(TR-CR-71; AD-602251)

The relative abundances of protons, deuterons, and tritons have been studied in photographic nuclear emulsion flown during the July 18th, 1961, solar flare event. These emulsions were exposed at a time and locality where there was a geomagnetic threshold, and the consequent enrichment of the abundance ratios has been used to reduce the abundance limits to lower values than those previously quoted. By including the results of previous α-particle measurements in these emulsions, it has been found that the relative abundances of solar produced H^1, H^2, H^3, and He above a given rigidity at this time were $1: \leq 1.4\ 10^{-2}: \leq 2.8\ 10^{-2}$: 0.17, and above energy of 50 Mev per nucleon, i.e., above a given velocity, were $1: \leq 2.10^{-3}: \leq 6.10^{-4}: 2.4\ 10^{-2}$. The consequences of these observations are briefly discussed. Author

N64-24909* Consultants and Designers, Inc., Arlington, Va.
ATMOSPHERIC PROCESSES AS A SOLAR ACTIVITY ACTION MECHANISM ON TECTONIC PHENOMENA [ATMOSFERNYYE PROTSESSY KAK MEKHANISM VOZDEYSTVIYA SOLNECHNOY AKTIVNOSTI NA TEKTONICHESKIYYE YAVLENIYA]
Transl. into ENGLISH from Doklady an SSSR, Geofizika, v. 155, no. 1, Mar. 1964 p 79–81
(NASA-TT-F-8692; ST-SP-ES-10136)

The mechanism of the relationship between seismic phenomena and solar activity was investigated. Results obtained as to the synchronous development of microseisms in Mirnyy and Pulkovo and, consequently, as to the synchronous course of atmospheric disturbances in both hemispheres, indicate that the increase in the intensity of atmospheric circulation is due to the energy of the solar corpuscular flux absorbed by the earth. This increase in atmospheric circulation would cause a variation in the angular moment of the earth's atmosphere, which in turn would cause a variation in the earth's total angular moment. I.v.L.

N64-24994 American Science and Engineering, Inc., Cambridge, Mass.
LUNAR X-RAY III Preliminary Report
H. Gursky 6 May 1963 12 p refs
(Contract AF 19(604)-1605)
(ASE-394; AD-601275)

The results from the third rocket, in a series, carrying payloads designed to measure small fluxes of soft X-rays are described. The rocket, an Aerobee 150, was successfully launched. The bulk of the data was obtained at altitudes greater than 350,000 ft and was accumulated by using the aspect sensors to place the local azimuth with respect to every rotation of the rocket. The data exhibit statistically significant peaks both in the local east and west. If the data were caused by electrons, complete symmetry with respect to the earth's magnetic field vector, which lies close to the local north–south line, would be expected. In comparing the data east of the magnetic field vector with that west of the field vector, an excess of 272 $\pm$100 counts is found in the west, out of a total of 9,414 accumulated counts. The principal observation, made from the sky map, is that the maximum counting rates were observed when looking toward the galactic equator and the minima were observed when looking away from the galactic equator. This, coupled with the fact that the counting rates were similar, substantiates conclusions drawn from an earlier flight. I.v.L.

N64-25004* National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
SHAPE OF THE GEOMAGNETIC FIELD SOLAR WIND BOUNDARY
Gilbert D. Mead and David B. Beard (California U.) Repr. from J. Geophys. Res., v. 69, no. 7, Apr. 1964 p 1169–1179 refs
(NASA-RP-214)

The shape of the boundary of the geomagnetic field in a solar wind has been calculated by a self-consistent method in which, in first order, approximate magnetic fields are used to calculate a boundary surface. The electric currents in this boundary produce magnetic fields, which can be calculated once the first surface is known. These are added to the dipole field to give more accurate fields, which are then used to compute a new surface. This iterative procedure converges rapidly, and the final surface may be tested by finding how close the total fields outside the boundary are to the required value of zero. The result of this stringent test is that the magnetic fields in the plasma outside the fourth surface and within twice the distance to the boundary on the solar side are everywhere less the 1% of the geomagnetic dipole field in the absence of a solar wind. Author

N64-25043 American Science and Engineering, Inc., Cambridge, Mass.
A PROGRAM OF RESEARCH FOR THE MEASUREMENT OF FLUORESCENT X-RADIATION FROM THE MOON AND FOR THE DETECTION OF OTHER X-RAY SOURCES IN THE NIGHT SKY
R. Giacconi, H. Gursky, and F. Paolini 20 Aug. 1963 83 p refs
(Contract AF 19(604)-8026)
(ASE-426; AD-601274)

This document describes a research program to investigate the fluorescent X-radiation from the lunar surface and other possible sources of X-rays in the night sky. A detailed description of a rocket experiment comprising large-area Geiger counters is presented. The results of two rocket flights carrying the experimental equipment are shown. One of these rocket flights resulted in the discovery of an intense source of X-rays, not of solar or terrestrial origin, in the direction of the constellation Scorpius. Also present is a considerable background of

soft radiation, which apparently is also X-radiation of nonsolar or terrestrial origin. Author

N64-25050* Consultants and Designers, Inc. Arlington, Va.
MEASUREMENT OF THE AGGREGATE RADIATION DOSE ABOARD SOVIET SPACESHIPS—SATELLITES "VOSTOK-5" AND "VOSTOK-6"
I. A. Savenko, K. F. Pisarenko, P. I. Shavrin, and B. E. Nesterov 11 May 1964 6 p refs
(Contract NAS5-2078)
(NASA-TT-F-8694)

Devices designed for the registration of penetrating radiation, primary cosmic radiation, and particles of the radiation belts and of solar cosmic rays, all generated during some chromospheric flares, were installed aboard Vostoks V and VI for operational dosimetric control. Discussed is the measurement of the aggregate radiation dose over a 70-hr portion of flight. G.D.B.

N64-25122 High Altitude Observatory, Boulder, Colo.
FLARE PREDICTION FROM SOLAR LIMB OBSERVATIONS
Lorne Avery and Donald E. Billings 5 May 1963 17 p ref
(Contract Nonr-393(06))
(HAO-ASTRO-GEOPHYS-MEMO-163; AD-439482)

The use of limb observations for advance warning of major solar flare activity is discussed. The advantage of using the limb data is that it provides warning 2 to 3 days earlier than disc observations. The method is not perfect, however, and is intended to augment rather than to replace the presently used disc observations. An obvious disadvantage of disc observations, not obviated by the limb data, is that predictions are possible only on clear days. G.D.B.

N64-25170* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
THE DETECTION OF SOLAR NEUTRINOS
Hubert Reeves (Montreal U.) [1964] 4 p Repr. from Sky and Telescope, v. 27, no. 5, May 1964

The plan for the Brookhaven Solar Neutrino Observatory, which will be buried thousands of feet underground and which will make possible for the first time a direct view of the center of the sun, is described. Basically, the observatory will consist of an enormous tank, roughly 20 ft in diameter and 40 ft long. In this tank, which contains perchloroethylene, Cl^{37} will capture the neutrinos from the sun. When Cl^{37} reacts with a neutrino, Ar^{37} is formed, plus an electron. Also, neutrino astronomy is discussed. I.v.L.

N64-25186* California U., Berkeley Space Sciences Lab.
[COMPILATION OF CONSOLIDATED REPORTS ON SCIENTIFIC RESEARCH SUPPORTED BY GOVERNMENT AGENCY GRANTS] Consolidated Quarterly Progress Report, Period Ending 1 Aug. 1963
Samuel Silver et al 26 Jul. 1963 40 p refs
(Contract NAS8-2634; NAS5-2222; Nonr-222(54); Grants NsG-243-62; NSF G-16741 et al)

Presented is a group of reports on space research projects including Solar Radiation and Atmospheric Absorption in the Millimeter Wave Region, Reaction Kinetics of Accelerating Flames, Infrared Planetary Observatory in the Stratosphere, Control and Information Systems, Space Physiology, and 15 other studies currently under progress. G.D.B.

N64-25321 Emmanuel Coll., Boston, Mass. Research Language Center
SCINTILLATIONS OBSERVED ON THE SUN AT A WAVELENGTH OF 3 CM, AND A THEORETICAL INTERPRETATION [SCINTILLATIONS OBSERVEES SUR LE SOLEIL A LA LONGUEUR D'ONDE DE 3 CM ET INTERPRETATION THEORIQUE]
J. Arsac (Paris Obs.) Bedford, Mass., AFCRL, Oct. 1963 9 p refs Transl. into ENGLISH from the FRENCH
(Contract AF 19(604)-8505)
(E-T-F-63-8; AD-440907)

Sunset was observed with a parabola 1.5 m in diameter, at a wavelength of 3 cm. When the height above the horizon is of the order of 10°, the energy received fluctuates abnormally, which, in certain respects, can be associated with atmospheric scintillation. Its essential characteristics are an increase in the mean square of the fluctuation with the zenith distance, almost in proportion to the secant of that distance, and an increase in the apparent period of the scintillations, with a tendency toward a pseudosinusoidal appearance (impoverishment of the frequency spectrum of fluctuations). In general, the pseudoperiod varies as $(\sec z)^{1/2}$. These phenomena are interpreted theoretically under the assumption that their frequency spectrum causes the changes in appearance. I.v.L.

N64-25333 Naval Research Lab., Washington, D.C. Nucleonics Div.
ORIGIN OF COSMIC RAYS IN SUPERNOVAE AND OTHER SOURCES
M. M. Shapiro (Weizmann Inst. of Sci.) 20 May 1963 8 p refs Lecture Presented at the Enrico Fermi Intern. School of Phys., Varenna, Italy, Aug. 1962
(NRL-5951; AD-408515)

The most powerful galactic sources of cosmic radiation appear to be supernova explosions. Among the characteristics that suggest that their expanding gaseous envelopes provide suitable conditions for cosmic-ray origin are the following: an enormous energy release, a copious supply of relativistic electrons, large-scale magnetic fields, extended masses of plasma moving at high velocities, indications of the propagation of hydromagnetic waves, and relatively high concentrations of heavier elements. Several mechanisms of acceleration are sketched. Some difficulties with the supernova hypothesis, and with other possible modes of origin, are briefly discussed. Author

N64-25530 Rochester U., N.Y.
A HEURISTIC MODEL FOR THE VARIATION WITH RIGIDITY OF THE COSMIC RAY CHARGE SPECTRUM
M. F. Kaplon and G. Skadron 12 Jun. 1964 54 p refs Submitted for Publication
(Grants AF-AFOSR-439-63; NSF GP-1372)
(URPA-39)

An idealized model based on the supernova origin of cosmic radiation is proposed to account for the variation with rigidity of the cosmic ray charge spectrum. It is assumed that a supernova explosion results in the injection of a pure power law spectrum and a composition relatively rich in heavy nuclei. Particles are confined within a volume local to the source region by a magnetic boundary resulting in a rigidity dependent coefficient of reflectivity; this yields a source region path length varying inversely with rigidity. As a result, the differential spectra of particles escaping from the boundary into the galaxy are determined by the reflectivity; and as a result of the nuclear interactions in the source region, the composition varies with rigidity. The additional effect of intragalactic motion is taken into account and the differential rigidity spectra, as a function of composition at the earth, are calculated. Author

N64-25566* Maryland U., College Park
THE TIME DEPENDENCE OF RADIATION BELT LIFETIMES AND SOME APPLICATIONS
Forrest E. England (M.S. Thesis) 1964 113 p refs
(Grant NsG-58-60)
(NASA-CR-56828) OTS: $9.60 ph

The lifetimes of particles in the radiation belt vary as a consequence of fluctuations of the loss processes such as produced by variations of atmospheric density with time. The time scale of atmospheric variations affects the averaged atmospheric density to which trapped particles are exposed and therefore determines the time dependence of the radiation lifetimes as set by the atmosphere. Since observations are usually made of the radiation flux rather than of lifetime, a number of models of injection and loss, which determine the resultant flux, are examined. Special cases of injection and removal are considered. Artificial injections such as Starfish can be used to investigate the particle lifetimes. Similarly, artificial removal by sweeper satellites modifies the radiation belt to enable physical properties of the radiation belt and its environment to be deduced. Author

N64-25619* Consultants and Designers, Inc., Arlington, Va.
GEOGRAPHICAL POSITION OF PARTICLE INTENSITY MAXIMA IN THE OUTER RADIATION BELT AT LOW ALTITUDES [GEOGRAFICHESKOYE POLOZHENIYE MAKSIMUMOV INTENSIVNOSTI CHASTITS VO VNESHNEM RADIATSIONNOM POYASE NA MALYKH VYSOTAKH]
S. N. Vernov, V. N. Yerofeyeva, V. E. Nesterov, I. A. Savenko, and P. I. Shavrin 9 Jun. 1964 10 p refs Transl. into ENGLISH from Kosmich. Issled. v. 2, no. 2, 1964 p 289–295
(Contract NAS5-2078)
(NASA-TT-F-8907; ST-PF-GM-10152)

The position of intensity maxima in the outer radiation belt is determined for flight altitudes of the second and third Soviet spaceships and of the satellite Cosmos-4. Comparison is made between the experimentally found maxima, the drift trajectories of the mirror points, and the aurora isochasms. Considered also is the connection between the position of intensity maxima and the degree of disturbance of the earth's magnetic field. Author

N64-25639 San Andres U., La Paz (Bolivia) Cosmic Physics Lab.
TIME VARIATIONS IN COSMIC RAYS AND RADIOSONDE MEASUREMENTS Final Technical Report
Ismael Escobar Jun. 1963 102 p refs *Its* Cuaderno no. 25
(Grant AF-AFOSR-62-395)
(AD-434540)

Changes in the electromagnetic states of interplanetary space produce temporal fluctuations in cosmic ray intensity as observed on the earth. The changes in the interplanetary electromagnetic states are, on the other hand, brought about by solar wind. The study of cosmic ray intensity variations, therefore, provides an easy way of obtaining information regarding the parameters that characterize the solar wind at any given time. Evidence available from the study of quiet day solar diurnal variation of cosmic rays indicates that solar wind velocity is usually above 100 km/sec and that the wind velocity undergoes a 22-year cyclic change. Author

N64-25660* State U. of Iowa, Iowa City
THE MORPHOLOGY OF THE ELECTRON DISTRIBUTION IN THE OUTER RADIATION ZONE AND NEAR THE MAGNETOSPHERIC BOUNDARY AS OBSERVED BY EXPLORER 12
John W. Freeman, Jr. Repr. from J. Geophys. Res., v. 69, no. 9, 1 May 1964 p 1691–1723 refs
(Grant NsG-233-62)

The elliptic orbit satellite Explorer XII made possible the routine survey of the heart of the outer radiation zone as well as the region of transition between the magnetosphere and interplanetary space on the sunward side of the earth by means of a variety of particle and magnetic field detectors. The data received from the SUI detectors during the entire 112-day lifetime were comprehensively analyzed. Salient features observed include confirmation of the enhancement of soft electron fluxes and diminution of hard electron fluxes in the outer zone during magnetically disturbed times; the outward motion of the outer zone hard electron maximum during periods of enhancement; confirmation of the general Chapman and Ferraro picture of a well-defined magnetosphere with compression of the geomagnetic field during the initial phases of magnetic storms; the existence of a layer of quasi-thermalized plasma immediately outside the magnetosphere; confirmation of the result of Frank and Van Allen that the contours of constant counting rate for electrons with $E \geq 40$ kev tend to protrude outward near 90° from the subsolar point and draw closer to the earth on the night side; and general support for the result of Gringauz, Kurt, Moroz, and Shklovskii that there exists a region beyond some $8R_e$ on the night side of the earth dominated by very-low-energy electrons. Author

N64-25824 Commissariat a l'Energie Atomique, Saclay (France)
CHARGE AND ENERGY SPECTRA OF Z < 3 PRIMARY AND SECONDARY COSMIC RAYS AT 46° GEOMAGNETIC LATITUDE
L. Koch, J. Engelmann, J. Labeyrie, and D. de Zertucha (1964) 13 p refs Presented at Fifth Intern. Space Sci. Symp., Florence, 12–16 May 1964

Charge and energy spectra of primary and secondary cosmic rays with a charge lower than 3 was studied with a balloon-borne dE/dx semiconductor spectrometer launched by a gondola; the geomagnetic latitude was 46° ±1° N and the rigidity cutoff was 4.7 Gev/c. The balloon floated 1 hr 15 min at 28.5 km, corresponding to a residual atmospheric depth of 15 g/cm^2. G.D.B.

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-24244* National Aeronautics and Space Administration, Washington, D.C. Scientific and Technical Information Div.
LUNAR SURFACE STUDIES. A CONTINUING BIBLIOGRAPHY
1964 102 p refs
(NASA-SP-7003) OTS: $2.25

This is an annotated bibliography on lunar surface studies compiled from journals during 1962, 1963, and 1964. J.L.D

N64-24260 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF THE COMMISSION ON PLANETARY PHYSICS Selected Articles
13 Dec. 1962 21 p refs Transl. into ENGLISH of two articles from Izv. Komis. Po Fiz. Planet (USSR), no. 2, 1960 p 46–54, 65–72
(FTD-TT-62-1514/1+2; AD-295436)

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N64-24261 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PRACTICE OF DETERMINING THE TEMPERATURE OF INDIVIDUAL PARTS OF LUNAR SURFACE
Yu. N. Chistyakov *In its* News of the Comm. on Planetary Phys. 13 Dec. 1962 p 1–11 refs (See N64-24260 17-29)

Preliminary results are reported of temperature measurements of lunar-surface sections with angular size of 1.5-minutes square. Observations were carried out with a vacuum-compensating thermocouple, 0.7-mm square, with a sensitivity of 10 v/w, set in the Newton focus of a 13-inch reflector of 1,600-mm focal length. Analysis was by a modified Menzel method. Radiation-absorbing atmospheric water vapor was calculated by the Hann formula. These results were obtained: temperature of the subsolar point near full moon equals 400° ±30° K; maria temperatures are higher than temperatures of surrounding areas; and the ratios of radiometric to visual albedo for individual sections are equal to the similar ratio of average albedos over the lunar disk. D.E.W.

N64-24262 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INDICATRICES OF REFLECTION OF INDIVIDUAL SECTIONS OF THE LUNAR SURFACE
N. P. Barabashov and V. I. Yezerskiy *In its* News of the Comm. on Planetary Phys. 13 Dec. 1962 p 12–17a refs (See N64-24260 17-29)

By applying the principle of optical reciprocity to data of a photometric catalog of the lunar surface, reflective indices of individual sections of the lunar surface were obtained and compared. D.E.W.

N64-24759 Joint Publications Research Service, Washington, D.C.
PROBLEMS OF COSMOGONY, VOLUME VII
25 May 1964 388 p refs Transl. into ENGLISH of Vopr. Kosmogonii, Akad. Nauk SSSR (Moscow), V. VII, 1960 p 1–383
(JPRS-24734; OTS-64-31318) OTS: $5.00

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5. DISTANCES AND MASSES OF PLANETS B. Yu. Levin p 60–62 refs (See N64-24764 17-05)

6. ACCUMULATION OF PLANETS OF THE EARTH GROUP V. S. Safronov p 63–68 refs (See N64-24765 17-05)

7. PROCESS OF FORMATION OF PLANETS IN THE EARTH GROUP V. A. Krat p 69–70 refs (See N64-24766 17-29)

8. THE ORIGIN OF METEORITES VIEWED IN CONNECTION WITH THE ORIGIN OF THE SOLAR SYSTEM H. C. Urey (Calif. U.) p 71–73 refs (See N64-24767 17-05)

9. THE ABUNDANCE OF THE ELEMENTS H. C. Urey and A. DuFresne p 74–90 refs (See N64-24768 17-29)

10. REMARKS ON THE FORMATION OF THE SOLAR SYSTEM FROM THE POINT OF VIEW OF NUCLEOGENESIS A. G. W. Cameron (AEA, Chalk River, Canada) p 91–93 refs (See N64-24769 17-29)

11. THE LUNAR SURFACE AND THE EARLY STAGES OF THE DEVELOPMENT OF THE SOLAR SYSTEM J. Kuiper (Yerkes Observatory) p 94–95 (See N64-24770 17-29)

12. REMARKS ON COMETS, METEORS AND PLANETARY EVOLUTION F. Whipple (Harvard Observatory) p 96–99 (See N64-24771 17-29)

13. ORIGIN OF THE EARTH V. A. Krat p 100–119 refs (See N64-24772 17-29)

14. THE FORMATION OF PROTOPLANETARY DUST CLOUDS V. S. Safronov p 120–145 refs (See N64-24773 17-29)

15. BEHAVIOR OF THE HYDROSPHERE UNDER MARTIAN CONDITIONS AND ITS OBSERVED MANIFESTATIONS V. D. Davydov p 146–166 refs (See N64-24774 17-29)

16. RADIANTS OF METEOR STREAMS BASED ON OBSERVATIONS IN CHINA IN THE FIRST MILLENIUM OF OUR ERA I. S. Astapovich p 167–179 refs (See N64-24775 17-29)

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18. ON THE CHEMICAL COMPOSITION OF STARS A. A. Boyarchuk p 208–225 refs (See N64-24777 17-29)

19. THE ENVELOPES OF Be STARS A. A. Boyarchuk p 228–250 refs (N64-24778 17-29)

20. THE SPECTRUM-LUMINOSITY DIAGRAM AND SOME PROBLEMS OF THE EVOLUTION OF HOT STARS I. M. Kopylov p 251–289 refs (See N64-24779 17-29)

21. SPECTROSCOPIC INVESTIGATIONS OF SHORT-PERIOD PULSATING STARS W. Iwanowska p 290–305 refs (See N64-24780 17-29)

22. THEORETICAL PRINCIPLES OF THE HYPOTHESIS OF THE ORIGIN OF DOUBLE STARS BY DIVISION R. A. Lyttleton p 306–315 refs (See N64-24781 17-29)

23. FURTHER REMARKS ON THE CENTRAL AND PERIPHERAL THEORIES OF STELLAR PULSATIONS S. A. Zhevakin p 316–326 refs (See N64-24782 17-29)

24. POLARIZATION OF THE RADIATION OF NEBULAE E. Ye. Khachikyan p 327–367 refs (See N64-24783 17-28)

N64-24760 Joint Publications Research Service, Washington, D.C.
QUESTIONS ASSOCIATED WITH THE PROBLEM OF THE ORIGIN OF THE SOLAR SYSTEM
H. Jeffreys (Cambridge U., England) *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 2–4 Presented at Gen.

Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

This is a critical discussion of the basic difficulties of current hypotheses advanced to explain the origin of planets. The author claims to be critical of all current cosmological theories. G.D.B.

N64-24761 Joint Publications Research Service, Washington, D.C.

THE FORMATION OF A PROTOPLANET

Ye. L. Ruskol and O. Yu. Schmidt *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 5–13 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

The hypothesis of the formation of planets from massive protoplanets of gaseous composition is criticized on the basis that the mass of such a protoplanetary cloud would be too great. This hypothesis is also not adequate to explain the chemical composition of the planets, their axial rotation, and other observed facts. G.D.B.

N64-24763 Joint Publications Research Service, Washington, D.C.

ON THE HYDROGEN CONTENT ON THE MAJOR PLANETS

A. I. Lebedinskiy *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 56–59 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

The differences in the chemical composition of the major planets are explained as being the result of the heating of the outer parts of the protoplanetary cloud by the motions of the massive bodies found in the region. P.V.E.

N64-24766 Joint Publications Research Service, Washington, D.C.

PROCESS OF FORMATION OF PLANETS IN THE EARTH GROUP

J. A. Krat *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 69–70 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

This is a hypothesis on the evolution of the sun and on the formation of the solar system that questions the validity of earlier hypotheses on this subject. It tries in some measure to explain the division of planets into those of the earth type and those called giant planets. G.D.B.

N64-24768 Joint Publications Research Service, Washington, D.C.

THE ABUNDANCE OF THE ELEMENTS

H. C. Urey and A. DuFresne (Chicago U.) *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 74–90 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

In constructing theories of the formation of the universe, cosmologists make use of information on the chemical composition of the stars and meteorites. There are current indications that the abundance ratios for several elements differ, as regarding the sun and meteorites. These discrepancies exceed the bounds of permissible errors of measurement. If the discrepancies represent something actual in nature, then there is evidence that the sun and the terrestrial planets represent different types of nucleogenesis. No chemical process was found to which meteoric material could have been subjected, and which could satisfactorily explain the observed differences without at the same time disrupting the regularity of the abundance curve. G.D.B.

N64-24769 Joint Publications Research Service, Washington, D.C.

REMARKS ON THE FORMATION OF THE SOLAR SYSTEM FROM THE POINT OF VIEW OF NUCLEOGENESIS

A. G. W. Cameron (AEA, Chalk River, Canada) *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 91–93 refs Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

It is suggested that the sun, the earth, and meteorites represent a single instance of nucleogenesis, and that existing differences in the abundances of various elements as observed in those bodies are the result of subsequent physical processes of cosmological development. Author

N64-24770 Joint Publications Research Service, Washington, D.C.

THE LUNAR SURFACE AND THE EARLY STAGES OF THE DEVELOPMENT OF THE SOLAR SYSTEM

J. Kuiper (Yerkes Observatory) *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 94–95 Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

Discussed are the peculiarities of lunar relief, and the role of fusion and the impacts of colliding bodies in the formation of the moon. Author

N64-24771 Joint Publications Research Service, Washington, D.C.

REMARKS ON COMETS, METEORS AND PLANETARY EVOLUTION

F. Whipple (Harvard Coll. Observatory) *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 96–99 Presented at Gen. Meeting of the Intern. Astron. Union, 15 and 19 Aug. 1958 (See N64-24759 17-29) OTS: $5.00

This is a discussion of comet accumulation in the outer parts of the solar system. Two completely different lines of investigation indicate the possible presence within comet material of submicroscopic meteoritic particles of high density. The agreement between these two independent preliminary studies of dense meteor particles of submicron dimension demands serious thought for an explanation of their origin. The majority of astronomers subscribe to some hypothesis of planetary evolution, developed as current variations of the Kant–Laplace hypothesis. G.D.B.

N64-24772 Joint Publications Research Service, Washington, D.C.

ORIGIN OF THE EARTH

V. A. Krat *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 100–119 refs (See N64-24759 17-29) OTS: $5.00

This discussion of the origin of the earth deals with the subject on the bases of the formation and development of the earth's crust in earliest geologic times, the evolution of the earth's atmosphere, the formation of the earth as a planet, and the gravitational and geochemical differentiation of matter. G.D.B.

N64-24773 Joint Publications Research Service, Washington, D.C.

THE FORMATION OF PROTOPLANETARY DUST CLOUDS

V. S. Safronov *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 120–145 refs (See N64-24759 17-29) OTS: $5.00

The formation of condensations and the rotation of these condensations are discussed. Described is the subsequent evolution and growth of condensations. G.D.B.

N64-24774 Joint Publications Research Service, Washington, D.C.
BEHAVIOR OF THE HYDROSPHERE UNDER MARTIAN CONDITIONS AND ITS OBSERVED MANIFESTATIONS
V. D. Davydov *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 146–166 refs (See N64-24759 17-29) OTS: $5.00

The propriety of comparing water resources on Earth to those on Mars is confirmed, even though the spectral method could not be used to detect water vapors in the Martian atmosphere. Oceanographic techniques are employed instead. G.D.B.

N64-24775 Joint Publications Research Service, Washington, D.C.
RADIANTS OF METEOR STREAMS BASED ON OBSERVATIONS IN CHINA IN THE FIRST MILLENIUM OF OUR ERA
I. S. Astapovich *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 167–179 refs (See N64-24759 17-29) OTS: $5.00

Ancient Chinese observations of meteor streams were analyzed, and data on 20 radiants were obtained. Five of them no longer exist. Of nine large streams now known, two were nonexistent at the time of the observations. For a millenium, streams persisted with orbits so situated that their perturbations from planets were at a minimum. G.D.B.

N64-24776 Joint Publications Research Service, Washington, D.C.
CORPUSCULAR RADIATION OF THE SUN AND ZODIACAL LIGHT
G. M. Nikol'skiy *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 180–207 refs (See N64-24759 17-29) OTS: $5.00

A number of arguments supporting the identification of stable corpuscular streams with mean latitude and equatorial coronal rays is given, as well as a survey of the studies dealing with the thermal dissipation from the corona. An attempt is made to connect the polar rays of the corona with polar faculae. The finite lifetime of polar rays can be explained by the outflow of their matter from the corona. Spectrographic and radio methods are considered for the estimation of gas concentration in interplanetary space. G.D.B.

N64-24777 Joint Publications Research Service, Washington, D.C.
ON THE CHEMICAL COMPOSITION OF STARS
A. A. Boyarchuk *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 208–225 refs (See N64-24759 17-29) OTS: $5.00

The precision of estimating the relative chemical composition of stellar atmospheres is considered. A mean chemical composition of normal stars is obtained and is adopted as a standard by which the chemical composition of a particular star may be compared. Included are the contents of chemical elements in cosmic objects. G.D.B.

N64-24778 Joint Publications Research Service, Washington, D.C.
THE ENVELOPES OF Be STARS
A. A. Boyarchuk *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 226–250 refs (See N64-24759 17-29) OTS: $5.00

The dimensions of envelopes of Class B stars are discussed, as well as envelope transparency and the nature of the emission of matter from B stars. The dimensions of B star envelopes have a small dispersion—there is no marked relationship to the rotational velocity. The envelopes of B stars are completely opaque at the central frequencies of the Bahner series. G.D.B.

N64-24779 Joint Publications Research Service, Washington, D.C.
THE SPECTRUM-LUMINOSITY DIAGRAM AND SOME PROBLEMS OF THE EVOLUTION OF HOT STARS
I. M. Kopylov *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 251–289 refs (See N64-24759 17-29) OTS: $5.00

One of the most important aspects of studying stellar origin and evolution is the development, in detail, of the structure of the spectrum-luminosity diagram as a whole, as well as the structure of its individual sequences; an attempt is made to accomplish this in this paper. G.D.B.

N64-24780 Joint Publications Research Service, Washington, D.C.
SPECTROSCOPIC INVESTIGATIONS OF SHORT-PERIOD PULSATING STARS
W. Iwanowska *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 290–305 refs (See N64-24759 17-29) OTS: $5.00

Presented are the most important findings of astrophysical research on short-period RR Lyrae, AR Persei, and dwarf cepheid variable stars. Investigations of these pulsating stars are important for problems of internal stellar structure and stability, and for questions of the structure of the galaxy and other star systems. G.D.B.

N64-24781 Joint Publications Research Service, Washington, D.C.
THEORETICAL PRINCIPLES OF THE HYPOTHESIS OF THE ORIGIN OF DOUBLE STARS BY DIVISION
R. A. Lyttleton *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 306–315 refs (See N64-24759 17-29) OTS: $5.00

This paper demonstrates that Jeans' conclusion that double stars originated from rotating single stars is not correct. Stability, evolution of a rotating liquid mass, the two-dimensional problem, and the ratio of masses are among the items examined to arrive at this conclusion. G.D.B.

N64-24782 Joint Publications Research Service, Washington, D.C.
FURTHER REMARKS ON THE CENTRAL AND PERIPHERAL THEORIES OF STELLAR PULSATIONS
S. A. Zhevakin *In its* Probl. of Cosmogony, Vol. VII 25 May 1964 p 316–326 refs (See N64-24759 17-29) OTS: $5.00

This paper is a criticism of recent papers by Frank-Kamenetskiy et al on the theory of the nonadiabatic oscillations of stars. Their solution of the system of differential equations fails to satisfy at least one of the two boundary conditions for the star's center, and therefore is not a solution of the boundary problem of nonadiabatic oscillations. G.D.B.

N64-24812* North American Aviation, Inc., Downey, Calif.
THE FEASIBILITY OF SPACECRAFT DECELERATION BY AERODYNAMIC BRAKING AT THE PLANET MARS
Gerald M. Hanley and Frank J. Lyon N.Y., AIAA [1964] 16 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contract NAS9-1748)
(AIAA Paper-64-479) AIAA: $0.50 members, $1.00 nonmembers

The feasibility of decelerating a spacecraft by aerodynamic braking to establish an orbit about the planet Mars is determined. The effect of vehicle shape on heat protection weight at a nominal entry velocity of 27,600 ft/sec and the effect of initial entry velocity on heat shielding of a selected configuration for entry velocities between 27,600 and 39,000 ft/sec are

studied. Because of the wide spread in current estimates of the constituents and density of the Martian atmosphere, their effect on the maximum deviations of heat protection weight and entry corridor depth is presented. The study results indicate that gas radiation is a major source of gasdynamic heating during atmospheric braking, even for entry at 27,600 ft/sec. Consequently, blunt shapes such as the Apollo configuration have higher heat protection weight requirements than finer shapes such as the M-2 and high L/D delta wing shapes. A modified conical vehicle having a half-cone angle of 18° and an $(L/D)_{max} = 1.16$ was studied to determine the effect of initial entry velocity on vehicle heat protection weight. Heat protection weight increases rapidly with velocity as radiant heating becomes a more dominant factor. Aerodynamic maneuvering during braking in the Mars atmosphere is also discussed to illustrate the effect of L/D on braking corridor depth and on the ability to change orbital planes. Mars aerodynamic deceleration appears technically feasible and highly attractive when compared to the use of retrothrust for orbiting Mars. Author

N64-24816* National Bureau of Standards, Washington, D.C.
A THEORETICAL STUDY OF THE MARTIAN AND CYTHEREAN IONOSPHERES
R. B. Norton Washington, NASA, Jul. 1964 58 p refs
(NASA Order R-65)
(NASA-TN-D-2333) OTS: $1.50

The approach to the theory of planetary ionospheres is made by reviewing the theory of the terrestrial ionosphere regions and applying this theory, with necessary modifications, to the planets Venus and Mars. Among the important procedures considered are the production of electrons, the exchange and recombination reactions, and finally, the diffusion of an electron–ion gas through the neutral gas. Author

N64-24823* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON A MODIFICATION OF HILL'S METHOD OF GENERAL PLANETARY PERTURBATIONS
Peter Musen Washington, NASA, Jul. 1964 19 p refs
(NASA-TN-D-2375) OTS: $0.50

A semianalytical theory of general planetary perturbations, which is somewhat akin to Hill's theory, is developed. In both methods the first-order perturbations coincide, but the theories of perturbations of higher orders are different. The inconveniences of Hill's method, namely, the triple integral in the perturbations of the radius vector and the redundant constant of integration, do not appear here. The short- and the long-period terms containing the squares of the small divisors are localized and combined. The form of decomposition of perturbations as used in this article leads to a system of differential equations easily integrable by Hill's procedure and to a symmetrical scheme for the computation of perturbations of higher orders. Author

N64-24826* Melpar, Inc., Falls Church, Va.
STUDY IN COMETARY ASTROPHYSICS
Vincent J. de Carlo Washington, NASA, Jul. 1964 26 p refs
(Contract NASw-589)
(NASA-CR-54) OTS: $0.75

A laboratory program to investigate the effect of radiation on a number of compounds of cometary importance has been concerned with a study of the flash photolysis of low temperature solids and the vacuum ultraviolet photolysis of low-pressure gases. Emission has been detected from the vacuum ultraviolet photolysis of CH_4 and C_2H_2, and the spectra for solid NH_3, H_2O, and CO_3 have been recorded. Author

N64-24873 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
THE CASE FOR A COHESIVE LUNAR SURFACE MODEL
J. D. Halajian Jun. 1964 62 p refs Presented at the Conf. on Geol. Probl. in Lunar Res., Sponsored by the N.Y. Acad. of Sci., N.Y., May 1964
(ADR-04-04-64.2)

The lunar dust controversy is reexamined in the light of new data and experiments. The interpretation of the data shows that cohesionless dust has to be either very fluffy in order to match the lunar photometry or densely packed in order to match the thermal inertia constant, $(k\rho c)^{-1/2}$, of the moon. The likeliest model that could satisfy both aspects of the data at once is a highly porous but cohesive material, such as a rock froth or slag. This conclusion is reached by the following "model-matching" and "environment-simulation" experiments: (1) photometry; (2) thermal measurements; (3) lava and soil behavior in vacuo. Author

N64-24896 Iowa State U., Iowa City
H_2^+ ABSORPTION AS A SOURCE OF CONTINUOUS OPACITY IN THE STELLAR ATMOSPHERES
Satoshi Matsushima Feb. 1964 9 p refs Presented at the Harvard Conf. on Model Stellar Atmospheres, 20–21 Jan. 1964
(SUI-64-4)

The ratio of the absorption coefficient of H_2^+ per unit mass of stellar matter to that of H^- is independent of all physical conditions in the stellar atmospheres except the temperature. Hence, the relative contribution of H_2^+ as a source of continuous opacity may be estimated in terms of temperature only. Such a calculation indicates that the absorption by H_2^+ is only a few percent of that due to H^- for the entire region of the spectrum of all the stars, except in the far ultraviolet where H^- absorption becomes negligibly small compared to the other sources of opacity. Since the temperature distribution has been found to be insensitive to a change of 10% in the absorption coefficient, it is concluded that H_2^+ absorption may be ignored in the computations of atmospheric models. Author

N64-24956* National Aeronautics and Space Administration, Washington, D.C.
PERSPECTIVE ON SPACE EXPLORATION
Eugene M. Emme Repr. from Airpower Historian, V. 11, No. 1, Jan. 1964 refs Presented at the Space Exploration Symp., Div. of Gen. Educ., N.Y. U., 1 Nov. 1963

The short history of space exploration is discussed against the background of the world conditions leading to the space age. American reliance on atomic energy as a strategic device and the consequent tendency to underrate the need for expanded rocket power permitted the Russians to open the space age with the Sputnik Satellite. NASA was created as a direct result of national decision in the face of the Sputnik challenge. The transfer of units and programs from other departments of the Federal Government to NASA during the first years is reviewed, and the early accomplishments in manned spaceflight and scientific satellite programs are summarized. No prediction can be made concerning the precise results of future space exploration except that the greatest history of space flight is yet to come. M.P.G.

N64-24975 General Electric Co., Philadelphia, Pa. Missiles and Space Div.
MOLECULAR OPTICAL THICKNESS OF LOW-DENSITY MODELS OF THE ATMOSPHERE OF MARS
E. L. Gray and K. L. Coulson Mar. 1964 31 p refs
(R645021; AD-437226)

Values of volume scattering coefficient and normal optical thickness for the revised estimates of the Martian atmosphere are given, as a function of altitude above the planetary surface, for eight selected wavelengths from 2500 to 10,000 A. Four models of the Martian atmosphere, as given by the Jet Propulsion Laboratory, are used, the surface pressure for the models being 11 mb (2 models), 15 mb, and 30 mb. Comparisons with the previous higher-density atmospheric models for Mars, and with the U.S. Standard Atmosphere, are shown, and the values of optical thickness are used to compute the energy directed outward from the top of a Rayleigh atmosphere on Mars. The computations show that the normal optical thickness is lower for the new models than for the previous models by approximately the ratio of the surface pressures. Author

N64-24977* National Aeronautics and Space Administration, Washington, D.C.
SPACE, THE NEW FRONTIER
James Dean, Victor Seigel et al [1963] 76 p

A popular review of U.S. space programs and their wider implications is presented. The topics discussed include space and you, the history of space flight, the solar system, general principles of space probes and satellites, unmanned satellites and sounding rockets, unmanned lunar and interplanetary spacecraft, manned space exploration, space launch vehicles, the biology of space, and the techniques of space exploration. A glossary of space terms that frequently appear in popular space literature is appended. M.P.G.

N64-24982 Aeronutronic, Newport Beach, Calif.
GENERAL PERTURBATION TECHNIQUES FOR SATELLITE ORBIT PREDICTION STUDY. VOLUME I: STUDY AND RESULTS
J. L. Arsenault, J. D. Enright, and C. Purcell Wright-Patterson AFB, Ohio, Avionics Lab., Apr. 1964 136 p
(Contract AF 04(695)-326)
(AL-TDR-64-70; AD-437476)

The available published general perturbations solutions for satellite motion about an oblate planet are surveyed and systematically tabulated. This tabulation is used in a qualitative analysis leading to the selection of techniques best suited for satellite orbit prediction. The theories adopted for programming and quantitative analysis are those of Brouwer; Izsak; Hall, Gawlowicz and Vahradian; Petty and Breakwell; and Aeronutronic. Parametric comparisons between these theories and a special perturbations method, presented in graphical form, provide a means for evaluating the orbit prediction characteristics of the theories. The study discloses that the Hall, Gawlowicz and Vahradian theory is the most accurate over a broad spectrum of orbital inclinations and eccentricities. The Aeronutronic theory is somewhat superior to those of Brouwer and Izsak. The Izsak results possess large periodic fluctuations but display mean secular errors generally smaller than those obtained by the Brouwer and Aeronutronic theories. The method of Petty and Breakwell proved intractable to the initialization process. Conclusions and recommendations based on the experimental findings are presented. Author

N64-25015* Electro-Optical Systems, Inc., Pasadena, Calif.
ION ROCKET SYSTEM RESEARCH AND DEVELOPMENT
G. Sohl, G. C. Reid, and R. C. Speiser 20 Jun. 1964 38 p
(Contract NAS3-5250)
(NASA-CR-54025; EOS-4920-Q-1) OTS: $3.60 ph

Work performed in the research and development program on an electron-bombardment cesium ion rocket system is reported. The facility for extended testing of the system and some initial tests are described. The performance of a permanent magnet version of the engine is reported, and the results of plasma distribution studies and autocathode improvement tests are discussed. Author

N64-25049* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
MARS ROUND TRIP MISSION ANALYSIS FOR THE UNFAVORABLE 1975–1985 TIME PERIOD
D. N. Lascody, E. D. Thorson, H. W. Hawthorne, and G. Markus N.Y., AIAA [1964] 15 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun. – 2 Jul. 1964
(Contract NAS8-11005)
(AIAA Paper-64-403) AIAA: $0.50 members, $1.00 nonmembers

An analysis was conducted to evaluate the vehicle requirements for a manned exploration of Mars during the 1975–1985 time period. The availability of desirable interplanetary transfers during the period in question is complicated by the large energy requirements associated with late 1970 departures and high solar activity with concomitant weight penalties experienced during the early 1980's. Promising missions, selected on the basis of minimum gross weight in Earth orbit, are available with long duration class transfers (800 to 1,000 days) during the entire period investigated but are restricted to the 1980's if short duration (360 to 600 days) missions are desired. The concept of multimission vehicle design is also developed and the vehicle's capability determined for several synodic periods. This vehicle, with a constant structural weight and tank size, is capable of performing round-trip missions of various durations during several synodic periods. Weight-saving techniques such as utilizing elliptical orbits at Earth departure and at Mars, planetary atmospheric braking, high-speed Earth entry, etc. were evaluated with regard to feasibility, weight, and cost. Resulting weight savings are not sufficient to justify the extra complexity required in the mode of operation. Author

N64-25098 State U. of Iowa, Iowa City
EFFECTS OF ERRORS IN THE ABSORPTION COEFFICIENT ON THE NON-GREY MODEL STELLAR ATMOSPHERES
Satoshi Matsushima and Yoichi Terashita Feb. 1964 9 p refs Presented at the Harvard Conf. on Model Stellar Atmospheres, 20–21 Jan. 1964
(SUI-64-3)

The effect on the nongray model atmosphere calculation due to errors of 10% to 50% in the continuous opacity is examined by constructing two solar-type model atmospheres in which different H^- absorption coefficients are used. In Model I, the old values of Chandrasekhar et al for both the bound-free and free-free absorption of H^-; in Model II, the values recently revised by Geltman, and Ohmura and Ohmura were used. The values for the bound-free absorption differ by 10% in the visible region, and those for the free–free absorption by 40% to 50% in the infrared. Other than H^-, only neutral hydrogen is taken into account as a source of opacity. The computation is based on the Averett–Krook iterative procedure, which yields a model strictly in radiative equilibrium. The temperature–pressure relations of the two models differ by only a fraction of 1%. On the other hand, a comparison of the color distribution of emergent flux reveals variations comparable to the differences in the absorption coefficients. The direction of flux variation due to the change in opacity is interpreted on the basis of the condition of flux constancy. Author

N64-25102 American Mathematical Society, New York, N.Y.
LECTURE NOTES PREPARED IN CONNECTION WITH THE SUMMER SEMINAR ON SPACE MATHEMATICS, PART III
1963 262 p refs Presented at Seminar, Held at Cornell U., Ithaca, N.Y., 1 Jul.–9 Aug. 1963
(Grants NsG-358; AF-AFOSR-258-63; NSF GE-2234; Contracts DA-31-124-ARO(D)-82; AT(30-1)-3164; Nonr-(6)-00025-63)
(NASA-CR-56203) OTS: $17.00 ph

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N64-25104 Cambridge U. (Gt. Brit.)
THE DOMINANT FEATURES OF THE LONG PERIOD LIBRATIONS OF THE TROJAN MINOR PLANETS
P. J. Message *In* Am. Math. Soc. Lecture Notes Prepared in Connection with the Summer Seminar on Space Math., Pt. III 1963 p 455–465 (See N64-25102 17-29) OTS: $17.00 ph

There is a class of solutions for the three-body problem in which the bodies move so that the triangle they define is always equilateral, as was shown by Lagrange. This type of solution found application in the study of the solar system with the discovery of minor planets moving so as to approximate such a configuration with the Sun and Jupiter. These planets are known as the "Trojan Planets." The present treatment seeks to present the long period features of motion in the vicinity of the equiangular triangle configurations, making use of the elements of an osculating orbit, and taking into account only the gravitational attractions of the Sun and Jupiter, which dominate the motion. R.T.K.

N64-25218 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME II: ELECTRONIC AND MECHANICAL COMPONENTS
D. J. Hamman and E. M. Wyler Huntsville, Ala., Army Missile Command, 1 Apr. 1964 169 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-151; AD-601876)

This report presents the results of a literature survey on space environmental effects upon materials and components. This literature survey emphasizes the effects of vacuum and space radiation on organic materials and on electronic and mechanical components and materials—interaction of electron and proton radiation, resistors, capacitors, thermistors, and relays. G.D.B.

N64-25244 Aerospace Corp., El Segundo, Calif. Electronics Div.
THE EFFECT OF GEOPHYSICAL AND GEODETIC UNCERTAINTIES AT LAUNCH AREA ON BALLISTIC MISSILE IMPACT ACCURACY
R. C. Gore 15 May 1964 64 p
(Contract AF 04(695)-269)
(BSD-TDR-63-256, Reissue A; TDR-269(4922)-2, Reissue A; supersedes BSD-TDR-63-256, TDR-269(4922)-2; AD-602214)

The effects of uncertainties in the geophysical and geodetic parameters related to the establishment of ballistic missile launch sites on the impact accuracy of the ballistic missile are derived analytically. Curves of the derived impact miss coefficients are presented for radio- and inetially-guided missiles for ranges of 500 to 21,000 nmi and burnout angles of 5° to 90° from the vertical. Author

N64-25247 Aerospace Corp., El Segundo, Calif. Electronics Div.
DYNAMIC ATMOSPHERIC EFFECTS UPON SATELLITE MOTION AND SATELLITE LIFETIME
R. W. Bruce 15 May 1964 36 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-51; TDR-269(4550-10)-8; AD-601962)

Various model atmospheres are examined with regard to their effect upon the prediction of satellite lifetime and satellite orbit ephemerides. High-speed computer results based upon the empirical dynamic model atmospheres of Paetzold and Jacchia are compared to corresponding results based on the ARDC 1959 static model atmosphere that has been in wide use in the United States. For the sake of completeness the atmospheric density profiles and dynamic models of Nicolet, King-Hele, Harris, and Priester are described together with static models such as CIRA 1961 and the U.S. Standard Atmosphere, 1962. It is shown for near-earth altitude regions that predicted values of satellite lifetime may differ by a factor of 30 depending upon whether use is made of a static or a dynamic model atmosphere. This is primarily due to the fact that the large long-term influence of the 11-year solar cycle can introduce appreciable differences between static models, which are patterned after a given time period, and dynamic models, which vary with time. In the case of satellite ephemeris prediction, short-term effects such as those due to geomagnetic disturbances that are not accountable with static models become important as well. The predicted in-track position of a typical satellite may be in error by approximately 10 km (5 nmi) after a 12-hr time period if an intense but unpredictable magnetic storm occurs in that interval. Author

N64-25283* National Aeronautics and Space Administration, Washington, D.C.
STELLAR EVOLUTION. II. THE HYDROGEN-BURNING PHASE OF A STAR OF 7.0 SOLAR MASSES [STERNENTWICKLUNG. II. DIE WASSERSTOFF-BRENNENDE PHASE EINES STERNS VON 7.0 SONNENMASSEN]
E. Hofmeister, R. Kippenhahn, and A. Weigert Jun. 1964 39 p refs Transl. into ENGLISH from the GERMAN
(NASA-TT-F-8741; MPI-PA-2-64)

A computer program was designed for investigating the evolution of a Population I star of 7.0 solar masses. The results presented are based on a sequence of 119 models, the first of which represents the homogeneous main sequence state and has a convective core containing 26% of the mass. The models describe the phase of depletion of hydrogen in the core and show the evolution into the red giant region. The luminosity is increased about 1 magnitude compared with the main sequence state. During the evolution of the red giant

state, the evolutionary track crosses the region of the Cepheids. Some aspects of the corresponding models are discussed.
G.D.B.

N64-25289* Consultants and Designers, Inc., Arlington, Va.
RADAR LOCATION OF PLANET JUPITER [RADIOLOKATSIYA PLANETY YUPITER]
V. A. Kotel'nikov, L. V. Apraksin, V. M. Dubrovin, M. D. Kislik, B. I. Kuznetsov et al 2 Jun. 1964 6 p refs Transl. into ENGLISH from Astron. Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 5, 1964 p 1037–1038
(Contract NAS5-2078)
(NASA-TT-F-8905; ST-RA-10149)

The radar location of Jupiter was conducted in the U.S.S.R. during September–October 1963. One of the oppositions was taken when Jupiter was from 590 to 600 million km from the Earth. The radar reflecting properties of Jupiter's surface were studied, and radio wave propagation to ultraremote distances was investigated.
I.v.L.

N64-25370 Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
A SEARCH FOR WATER VAPOR AND TRACE CONSTITUENTS IN THE VENUS ATMOSPHERE
Hyron Spinrad Repr. from Icarus, v. 1, no. 3, Oct. 1962 p 266–700 refs

An unsuccessful spectroscopic search for water vapor and other gases in the Venus atmosphere is described. The resulting upper limit on the Cytherean water vapor–atmosphere mixing ratio down to a level of high temperature and pressure is about 10^{-5}.
Author

N64-25444 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DEPENDENCE OF METEOR HEIGHT ON SOLAR ACTIVITY
Kh. D. Gul'medov, K. A. Lyubarskiy, and I. N. Latyshev 18 May 1964 4 p Transl. into ENGLISH from Izv. Akad. Nauk Turkm. SSR, Ser. Fiz.-Tekhn., Khim. i Geol. Nauk (USSR), no. 6, 1960 p 141
(FTD-TT-62-1731/1+4; AD-601542)

Solar activity has a strong effect on such atmospheric parameters as density and temperature. Ultraviolet and corpuscular radiation give rise to heating and expansion of the atmosphere and fluctuation of isobaric surfaces. Meteor heights are a function of the density and temperature of the atmosphere and may serve as a sensitive indicator of their variation. An attempt was made to determine the dependence of meteor height on solar activity by photographic observations of meteors; the effects of seasonal fluctuations were eliminated. The geocentric velocity of meteors has a strong effect on their height. The data obtained showed that meteor heights decrease with an increase in solar activity.
G.D.B.

N64-25475 Harvard Coll. Observatory, Cambridge, Mass.
RESEARCH DIRECTED TOWARD THE PRODUCTION OF A MAP OF THE VISIBLE FEATURES OF MARS Final Report
D. H. Menzel, A. T. Young, G. De Vaucouleurs, W. S. Finsen, and R. B. Leighton Apr. 1964 55 p refs
(Contract AF 19(604)-7461)
(AFCRL-64-396; AD-601634)

Areocentric coordinates of about 150 Martian surface features are determined from photographs taken at the 1954 and 1956 oppositions. The data lead to the tentative conclusion that the flattening of the solid surface of the planet is about twice the dynamical value. The coordinates of a large number of clouds and other temporary features are also given.
Author

N64-25481 Canadian Armament Research and Development Establishment, Valcartier
ATMOSPHERIC ABSORPTION IN THE 2 TO 5 MICRON REGION OF THE SOLAR SPECTRUM AT 40,000 FEET
P. Roney (Computing Devices of Canada, Ltd.) May 1964 28 p refs
(CARDE-TR-475/64)

Solar absorption spectra, in the 2μ to 5μ region, are presented for various atmospheric slant paths from an altitude of 40,000 ft. The spectra were obtained from an aircraft platform, using a low-resolution prism spectrometer, over Quebec, Ascension Island, and Florida. Some estimates are made of the stratospheric concentrations of CO_2, CH_4, N_2O, and H_2O by reference to laboratory experiments with these gases.
Author

N64-25519 Paris Observatory, Meudon (France) Astrophysics Section
SYNOPTIC CHARTS OF THE SOLAR CHROMOSPHERE AND LISTS OF FILAMENTS AND ACTIVITY CENTERS, VOLUME IV, PART III, YEARS 1962–1963 [CARTES SYNOPTIQUES DE LA CHROMOSPHERE SOLAIRE ET CATALOGUES DES FILAMENTS ET DES CENTRES D'ACTIVITE, VOLUME IV, FASCICULE III, ANNEES 1962–1963]
E. Neyvoz, G. Olivieri, and D. Durain Mar. 1964 83 p In FRENCH
(Partially sponsored by UNESCO)

Twenty-seven synoptic charts of the solar chromosphere, which correspond to the period from December 28, 1961 to January 3, 1964, and a catalog of the filaments and the centers of activity, observed during this period, are presented.
Trans. by I.v.L.

N64-25629 Aeronautical Chart and Information Center, St. Louis, Mo. Chart Research Div.
RELIEF OF THE EDGE ZONE OF THE MOON [REL'EF KRAYEVOY ZONY LUNY]
A. A. Gorynya and V. K. Drofa Apr. 1963 14 p Transl. into ENGLISH from a Publication of the Main Astron. Obs., Ukrain. Acad. of Sci. (Kiev), 1962
(TC-612)

The purpose of this work is the study of the moon's profile with different librations. The data obtained can be employed in the future for the compilation of maps of the relief of the moon's marginal belt. Photographs of the moon, obtained on the astrograph, are the basis of the present work. The following elements are included in the processing of the data: (1) the measurement of photographs; (2) the determination of the scale of the plates; (3) the corrections for refraction; (4) the computation of the radii of the most probable circumferences, which represent the moon's visible discs; and (5) the determination of the deviations of the real limb from these radii. Computations are presented that give the position of the 4281 points of the moon's profile with regard to the most probable circumference. In order to complete this work, it is necessary to refer the obtained points of the profile to the surface of the barycentric sphere of the determined radii. This problem has not yet been solved.
I.v.L.

N64-25637 Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronics Systems
DYNAMIC PROGRAMMING TECHNIQUES Final Report
11 Dec. 1963 95 p refs
(Contract AF 30(602)-2770)
(RADC-TDR-64-10; AD-433897)

The general theory of the recursive formulation of optimization problems is developed. The conditions under which the problem of minimizing a functional over an abstract set that can be given a recursive formulation are analyzed; the distinction between deterministic and nondeterministic programing problems is included. The degree of state dependence of the criterion functional and the degree of Markovian character of the stochastic process generating system trajectories are analyzed for their effect on the recursive formulation. The recursive solution of the problem of finding the minimum value of a functional defined on a collection of curves is considered, and the conditions under which the differential relation may be rigorously established are developed. A careful, heuristic derivation of the Pontryagin Maximum Principle from this differential relation is also given. Problems discussed include the optimum scheduling of link-to-satellite assignments in a nonsynchronous satellite communications system and the computation of optimum discrete allocations. Author

N64-25650 RAND Corp., Santa Monica, Calif.
THE PHYSICS OF METEOR ENTRY
Mary F. Romig Apr. 1964 43 p refs
(P-2902; AD-438437)

A survey is made of recent papers on the physics of meteor entry. The various regimes of luminous flight are defined, and present techniques for obtaining the mass and density of meteoroids are critically discussed. The effect of the assumed mode of heat transfer on the mass loss is shown for two recent fireballs. A relatively simple method for estimating original mass and velocity is presented. Author

N64-25680* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
LUNAR SEISMOLOGY
R. L. Kovach and F. Press 10 Aug. 1962 15 p refs
(Contract NAS7-100)
(NASA-CR-56971; JPL-TR-32-328)

A knowledge of the seismicity of the moon will provide an insight into its thermal and tectonic history. Analyses of lunar seismograms from a simple passive experiment should give an estimate of the composition of the moon and indicate its main internal structural features, such as the presence of a lunar crust and core. Meteor impacts will most probably be recorded by a lunar seismograph, even though the task of distinguishing such impacts from natural moonquakes may prove to be difficult. A single-axis seismometer will be carried aboard Ranger V, and the data from any lunar seismic disturbances will be telemetered to earth for subsequent analyses. More sophisticated active seismic experiments can contribute important information on the regional and location variations in the internal structure of the moon and should rank high in priority for future lunar missions. Author

N64-25682* Jet Propulsion Lab., Calif. Inst. of Tech., Pasa-Dena.
SYMPOSIUM ON RADAR AND RADIOMETRIC OBSERVATIONS OF VENUS DURING THE 1962 CONJUNCTION
F. T. Barath, ed. Repr. from the Astron. J., v. 69, no. 1, Feb. 1964 77 p refs
(Contract NAS7-100)
(NASA-CR-56656; JPL-TR-32-533) OTS: $7.60 ph

The antenna feed system employed during the 1962 Venus radar experiment permitted the remote automatic selection of the sense of circularity independently for both transmitting and receiving. During most of the experiment, right-handed circularly polarized energy was transmitted and left-handed circularly polarized energy was received. (Specular reflection reverses the sense of circularly polarized energy.) Several times during the experiment, however, right-handed circularly polarized energy was both transmitted and received. The depolarized component was found to be approximately 11.5 db below the matched component. An integrated spectrum of the depolarized component was compared with the matched return. Although the spectrum is extremely noisy, it appears that the depolarized echo-scattering law lies somewhere between Lambert and Lommel–Seeliger scattering, characteristic of a rough surface. The matched component has a very pronounced specular spike, expected from a smooth reflector. Author

N64-25706* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INTERPLANETARY TRAJECTORY ANALYSIS FOR MISSIONS FROM EARTH TO MERCURY, JUPITER, AND SATURN
11 May 1964 253 p refs
(NASA-TM-X-53046) OTS: $16.50 ph

Trajectory data for interplanetary missions originating on Earth during the 1968 to 1980 era and terminating at the planets Mercury, Jupiter, and Saturn are presented. The data presented are confined to these injections with energy requirements that are within the anticipated capabilities of launch vehicles that may be available within this time period. Author

N64-25709* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GODDARD SPACE FLIGHT CENTER CONTRIBUTIONS TO THE COSPAR MEETING
Washington, NASA Jun. 1964 95 p refs
(NASA-TN-D-2303)

The general properties of the atmospheres of Mars, Venus, and Jupiter are reviewed. The evolutionary processes of planetary atmospheres are outlined as an introduction to a detailed discussion of the structure of the atmospheres of other planets. The most recent observational results indicate that the surface pressure on Mars may be about 20 mb, and the abundance of CO_2 in the atmosphere of Mars about 25% by volume. For Venus there are indications that the surface pressure is about 100 atm, with the atmosphere mainly composed of N_2. In the case of Jupiter, recent theoretical investigations of the atmosphere below the clouds suggest that there may be regions in the atmosphere of very high density and pressure but at relatively low temperature, creating conditions possibly favorable to the occurrence of complex organic reactions. Author

N64-25736* Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
OPTICAL RADAR RESULTS AND METEORIC FRAGMENTATION
G. Fiocco and G. Colombo (Smithsonian Astrophys. Obs.) Repr. from J. of Geophys. Res., v. 69, no. 9, 1 May 1964 p 1795–1803 refs
(Grants NsG-419; NsG-87-60)

Recent optical radar experiments using a ruby laser as the source of radiation have indicated the existence of a scattering layer in the upper atmosphere at an altitude between 110 and 140 km. The echoes were tentatively interpreted in accordance with a model of meteoric fragmentation and have been related to other experimental results. By progressive fragmentation in its flight through the atmosphere, a meteoroid should show an enhancement of cross section, which

is responsible for those echoes. The atmosphere would be working as a filter, and the average size distribution of micrometeorites would vary with the height. IAA

N64-25737* Michigan U., Ann Arbor Space Physics Research Lab.
VARIATION OF THE LUNAR ATMOSPHERE WITH THE STRENGTH OF THE SOLAR WIND
F. L. Hinton and D. R. Taeusch Repr. from J. of Geophys. Res. v. 69, no. 7, 1 Apr. 1964 p 1341–1347 refs
(Contract NASw-133)

A simplified model of the lunar atmosphere is used to calculate average densities of seven different neutral gases and their ionized components, near the moon's surface, as a function of the solar corpuscular flux J. The method of calculation takes into account, in a unified way, the effect of sources of gas in the lunar crust as well as accretion by the solar wind, and the escape of gases by thermal evaporation and photoionization as well as interaction with the solar wind. For $10^7/cm^2sec < J < 10^9/cm^2sec$, the main constituents of the lunar atmosphere are argon, constant at about 5×10^4 cm^3, and neon, which increases linearly with J. For $10^9/cm^2$ $sec < J < 10^{11}/cm^2$ sec, argon and water vapor decrease with increasing J, whereas hydrogen, helium, and neon increase. For $10^{11}/cm^2$ sec $< J < 10^{13}/cm^2$ sec, the densities of argon, neon, hydrogen, and helium take on the approximately constant values (independent of J) of $2 \times 10^3/cm^3$, $2.8 \times 10^5/cm^3$, $3.1 \times 10^5/cm^3$, and $1.5 \times 10^6/cm^3$, respectively. Hence, the total number density of gas from the sources considered will not exceed $2.1 \times 10^6/cm^3$, regardless of how strong the solar flux may become. The densities of krypton and xenon will never be larger than $0.38/cm^3$ and $0.057/cm^3$, respectively. The only gases that contribute appreciably to the ionosphere are neon and argon. Author

N64-25743* California U., La Jolla
THE DISTRIBUTION OF GERMANIUM AND TIN IN METEORITES
Masako Shima Repr. from Geochim. et Cosmochim. Acta, v. 28, 1964 p 517–532 refs
(Grant NsG-323; Contract AT(11-1)-34)

Germanium and tin in 17 chondrites including an enstatite chondrite and a carbonaceous chondrite, 14 iron meteorites, one separated troilite phase, and three separated phases of two stony-iron meteorites were analyzed by a colorimetric method using germanium-dimethyl-aminophenyl fluorone complex and tin-dithol complex. Analytical data for germanium in ordinary chondrites and iron meteorites confirm earlier results. From the data for tin, it is found that tin varies in concentration in chondrites as well as in iron meteorites. A minor revision of the classification of meteorites made by Lovering et al. is suggested from data on tin in iron meteorites. Calculations of ΔF values show that germanium and tin are expected to be siderophile at high temperatures and lithophile at low temperatures. Nevertheless, analytical data on whole samples emphasize the siderophile properties of germanium and tin and to some degree the chalcophile properties of germanium. A discussion of this point is presented and extended to the evolution of meteorites. Author

N64-25745 Michigan U., Ann Arbor Radar Lab.
AN EXPERIMENTAL STUDY OF RAPID PHASE FLUCTUATIONS INDUCED ALONG A SATELLITE-TO-EARTH PROGATION PATH
Leonard J. Porcello Apr. 1964 125 p refs
(Contract AF 33(616)-8365)
(Rept.-4563-67-T; AD-437587)

An experiment is described having as its objective the examination of high-frequency phase fluctuations induced by the atmosphere along a satellite-to-ground propagation path. The phase fluctuations of interest lie in a spectral band ranging from approximately 0.1 cps to a maximum of 3 kc; the radiofrequencies employed range from 54 to 400 mc. The ionosphere-induced component of the observed phase fluctuation is of primary interest. Two classes of measurement are discussed; the first relies only upon use of a single highly stable sinusoidal emission from the satellite, whereas the second requires the emission of two harmonically related sinusoids, coherent with each other. Single-frequency measurements are reported at radiofrequencies of 54, 150, 324, and 400 mc, in the spectral band from 10 to 3,000 cps. Except in the 54-mc observation, the observed phase fluctuation spectral density appears to be close to the noise-induced phase spectrum threshold of about 10^{-6} to 10^{-5} rad^2/cps for spectral frequencies above 100 cps; where a separation can be made, it is apparent that the source is either the troposphere or oscillator properties. At 54 mc, pronounced ionospherically induced effects are noticeable. Two-frequency measurements at 162 and 324 mc are discussed; data collected from six passes of satellite ANNA 1B are presented. Author

N64-25760 Manchester U., Macclesfield (Gt. Brit.)
OBSERVATIONS OF THE FREQUENCY DEPENDENCE OF POLARISATION OF THE LIGHT OF THE MOON AND OF MARS Technical Note No. 3
David Clarke 13 Jan. 1964 47 p refs
(Contract AF 61(052)-378)
(AFCRL-64-442; AD-602668)

Some equations are established for determining the degree of polarization of the light of the Moon and Mars. Summarized are the more recent results of measurements of lunar polarization, and listed are the results obtained by the double beam polarimeter. Measurements of the polarization at different wavelengths were made on Mars and the Moon at several phase angles. The direction of vibration of the partially polarized light from both these bodies rotated with the phase angle. This effect was not previously observed on Mars, and was observed on the Moon only in white light. A method of using the wavelength dependence of lunar polarization to obtain values of lunar albedo at different wavelengths is discussed. Results on the planets Jupiter and Uranus are also tabulated. Also discussed are some further methods of calibrating a polarimeter. Author

N64-25775* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
CONVECTIVE HEAT TRANSFER IN PLANETARY ATMOSPHERES
Daniel J. Collins 1 Jul. 1964 12 p refs
(Contract NAS7-100)
(NASA-CR-56972; JPL-TR-32-629) OTS: $1.60 ph

Convective heat transfer rates for three model planetary atmospheres have been obtained. These atmospheres are characteristic of those about the planets Mars and Venus. Atmospheres consisting of nitrogen and carbon dioxide gave heat-transfer rates similar to that of air. The presence of argon materially increased the heat-transfer rate. The effects of different gage materials on the convective heat transfer were also measured. No major differences were found for the experimental conditions studied. Author

N64-25787 Joint Publications Research Service, Washington, D.C.
GRAVITATIONAL WAVES AND "SUPERSTARS"
I. S. Shklovskiy and N. S. Kardashev 8 Jul. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 5, 11 Apr. 1964 p 1039–1041
(JPRS-25399; TT-64-31672) OTS: $0.50

This report deals with certain important aspects of the general theory of relativity that are applicable to problems of superstars and gravitational collapse. Two possible mechanisms of the radiation of gravitational waves by a supermassive collapsing object are discussed: (1) The rate of rotation will increase rapidly due to the preservation of rotary momentum in compression, if the star rotated before it collapsed. (2) Gravitational waves may be generated in the anisotropic compression of a massive body, such as the compression of a biaxial ellipsoid along the axis of rotation. It is indicated that a marked reduction in the mass and rotary momentum of the collapsing superstar should be expected because of the powerful radiation of gravitational waves. Also, the energy density of gravitational waves in the vicinity of a collapsing star must be very great. Therefore, the possibility of a transition of some part of this energy into other forms such as electromagnetic or kinetic energy, cannot be excluded. I.v.L.

N64-25788* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EMISSION OF GRAVITATIONAL WAVES BY BODIES MOVING IN A COLLAPSING STAR FIELD [IZLUCHENIYE GRAVITATSIONNYKH VOLN TELAMI DVIZHUSHCHIMISYA V POLE KOLLAPSIRUYUSHCHEY ZVEZDY]
Ya. B. Zel'dovich and I. D. Novikov 23 Jun. 1964 8 p refs Transl. into ENGLISH from Astron., Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 5, 1964 p 1033–1036
(NASA-TT-F-8914; ST-IGA-10160)

This paper considers the gravitational wave emission by a body of mass m, moving in a spherically symmetric field of a greater mass M, and the effect of this emission on the motion of the mass m and the possible observable effects caused by such gravitational emission. G.D.B.

N64-25805* National Aeronautics and Space Administration, Washington, D.C.
INTERPLANETARY DUST PARTICLES OF MICRON SIZE PROBABLY ASSOCIATED WITH THE LEONID METEOR STREAM
W. M. Alexander, C. W. Mc Cracken, and H. E. La Gow Dec. 1961 9 p refs
(NASA-TN-D-1154) OTS: $0.50

An interplanetary dust particle event, coincident with the Leonid meteor shower and lasting approximately 70 hr, was recorded by a sensor on the Vanguard III satellite. During this interval, the satellite's microphone system registered impacts of approximately 2,800 dust particles with momenta exceeding 10^{-2} dyne-second. The impact rate varied by as much as two orders of magnitude within a few hours. The microphone system was almost omnidirectional, so the radiants of the dust particles cannot be defined. Association of these dust particles with the Leonid meteor stream is suggested by the coincidence in time and by the location of the satellite. Vanguard III traversed five major meteor streams, but the impact rates significantly exceeded the background rate only during this one interval. This is the first case in which a significant increase in the directly measured impact rate of dust particles can possibly be associated with a major meteor stream. Author

N64-25820 Lockheed-California Co., Burbank
RESEARCH ON SOLAR MAGNETIC FIELDS Quarterly Letter Report No. 5
D. S. Webber 6 May 1964 6 p
(Contract Nonr-3933(00); ARPA Order 215)
(LAC/422637; AD-439513)

Three major steps in determining the nature of local magnetic regions through statistical analyses were taken: (1) The transfer to punched card format of the tabulated magnetic region, calcium plage, and sunspot data was accomplished. (2) A tabulation of all magnetic regions and of their corresponding calcium plages within specified limits was obtained from a computer program. (3) Synoptic charts were constructed from isogauss maps, each chart being a composite of the magnetic characteristics of the sun for one revolution or 27 days. G.D.B.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-24590* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SPECTROGRAPHIC DATA OBTAINED FROM REENTRIES AT 10.9 AND 8.1 KILOMETERS PER SECOND OF TWO STAGES OF TRAILBLAZER IIb
Kenneth H. Crumbly Washington, NASA, Jul. 1964 23 p refs
(NASA-TN-D-2347) OTS: $0.75

Recent efforts in obtaining optical data from reentry vehicles have resulted in a spectrogram of the fourth and fifth stages of a Trailblazer IIb rocket reentering at 8.1 and 10.9 km/sec, respectively. These data were obtained by a ground-based slitless spectrograph equipped with a 400 groove/mm transmission grating, which gives a line resolution of approximately 10 A. The fourth-stage reentry ablative elements were identified as iron, magnesium, chromium, calcium, sodium, manganese, and nickel. The fifth-stage reentry ablative materials were identified as aluminum, magnesium, and aluminum oxide. A short discussion is presented on various radiometric aspects of the two reentries. Author

N64-24868 General Motors Corp., Milwaukee, Wis. AC Spark Plug Div.
PROGRAM 624A-TITAN III. INERTIAL GUIDANCE SYSTEM Quarterly Program Progress Report, including Reliability and Quality Assurance Program Status, 1 Jan.–31 Mar. 1964
30 Apr. 1964 60 p refs
(Contract AF 04(695)-282)
(I-O-25; Rept.-64-20A; AD-437494)

Work is summarized in the following areas of the development program for the 624A Titan III inertial guidance system: (1) design and development—system-engineering activities, equipment-design activities, and test-equipment engineering activities; (2) test programs—inplant test program and field-site test programs; (3) support activities, training, and manuals—logistics, maintenance engineering, PERT operations, packaging engineering, training, field service publications; and (4) reliability and quality assurance programs. P.V.E.

N64-24886 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
R. Valid [1963] 12 p Presented at the 17th Meeting of the AGARD Panel on Struct. and Mater., London, 2–10 Sep. 1963 In FRENCH

This is a general survey of some preliminary studies made in France on the causes of vibrations in missiles, and some possible ways to reduce them. The problem is approached by looking at the external structure, acoustic energy, types of propellants, stage separation, aerodynamic instabilities, and other factors contributing to vibration. G.D.B.

N64-24930 Purdue U., Lafayette, Ind. School of Aeronautical Engineering
TOPICS IN DYNAMIC PROGRAMMING FOR ROCKETS
Angelo Miele and James O. Cappellari, Jr. Jul. 1958 69 p refs
Jul. 1958 69 p refs
(Contract AF 18(603)-69)
(A-58-5; AFOSR-TN-58-685; AD-162218)

The programing of optimum trajectories for rocket-powered vehicles is investigated, with particular attention to the following problems: (1) stationary conditions for problems involving time associated with vertical trajectories, computed according to a simple approximate relationship between altitude and Mach number that holds for all drag functions; (2) Legendre–Clebsch condition for level flight, including a discussion of the second variation in connection with the optimization of the thrust modulus for constant altitude flight; (3) programing thrust direction, including aerodynamic forces; (4) programing thrust direction and thrust modulus in vacuum flight; and (5) maximum range in vacuum flight for the case in which both the initial- and final-path inclinations are free and the velocity modulus at the final point is also free. M.P.G.

N64-25048* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A LIGHTWEIGHT INSULATION SYSTEM FOR LIQUID HYDROGEN TANKS OF BOOST VEHICLES
Porter J. Perkins, Jr. and Jack B. Esgar [1963] 12 p refs Repr. from AIAA Struct. & Mater., v. CP8

The basic concept of a hermetically sealed foam insulation was investigated. Successful initial results prompted an extension of this sealed concept in an insulation system for a full-scale liquid hydrogen tank. The results of this latter investigation are described. This new insulation system consists of low-density polyurethane foam, covered and hermetically sealed with a thin-film laminate of Mylar and aluminum foil. Panels of this construction are bonded and sealed to the outside walls of the tank. Structural rigidity of the insulation panels is achieved by constricting the panels to the tank with a prestressed wrap of Fiberglass yarn, resulting in an extremely lightweight insulation system. G.D.B.

N64-25071* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE EFFECTS OF NEW LARGE LAUNCH VEHICLES ON THE COST EFFECTIVENESS OF THE NATIONAL BOOSTER PROGRAM
H. H. Koelle and R. G. Voss N.Y., AIAA [1964] 8 p Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun. – 2 Jul. 1964
(AIAA Paper-64-278) AIAA: $0.50 members, $1.00 nonmembers

This paper attempts to establish the general trend in earth-to-orbit transportation economics based on the available and approved launch vehicles of the national booster program. Only chemical propulsion systems are considered because there is little evidence at this time that nuclear propulsion systems will become economically competitive in the forseeable future. A rough estimate is made of the probable technological improvements in this area for the next 25 years. G.D.B.

N64-25189* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FLIGHT INVESTIGATION OF ABLATION ON A BLUNTED CYLINDER-FLARE CONFIGURATION TO A MACH NUMBER OF 8.48
Clyde W. Winters and William G. Witte Washington, NASA, Jul. 1964 43 p refs
(NASA-TN-D-2354) OTS: $1.25

A three-stage rocket-propelled research-vehicle system was flown to Mach 8.48 at an altitude of 25,000 ft, to determine the ablation characteristics of Teflon in free flight. Continuous in-flight measurements were made on the front face of the model by using variable-capacitance sensors. The ablated-length measurements were in good agreement with analytical predictions. In addition, temperature measurements were obtained under an unprotected inconel segment and a Teflon and inconel composite segment on a cylindrical test section and on the stabilizing flare of the model. Heating rates computed from these measurements were in good agreement with predicted values. A NASA computer program was used to obtain temperature histories and ablation rates on the Teflon and inconel composite cylindrical test section. Inside inconel wall temperatures obtained from this program were in good agreement with measured temperatures. Author

N64-25337 Martin Co., Denver, Colo. Aerospace Div.
VIBRATION ANALYSIS REPORT: PROGRAM 624A, CONFIGURATION A
C. Bodley, D. Yagi, and C. Schultz Jul. 1964 317 p refs
(Contract AF 04(695)-150)
(SSD-CR-64-103; AD-442496)

This report includes vibration analysis for the Titan II configuration A vehicle. The data include modal deflections, frequencies, and transfer function gains, which are computed in support of the vehicle autopilot design and dynamic stability analysis. Stages I and II are analyzed in such a manner that the pitch bending, yaw bending, roll torsion, and longitudinal vibration data are independent of one another. For the transtage flight, this cannot be done, due to the high degree of coupling in the transtage degrees-of-freedom. I.v.L.

N64-25569* Honeywell, Minneapolis, Minn. Military Products Group Research Dept.
ROCKET BOOSTER CONTROL. SECTION 2: CONTROL OF PLANTS WHOSE REPRESENTATION CONTAINS DERIVATIVES OF THE CONTROL VARIABLE
W. W. Schmaedeke 7 Jan. 1964 19 p refs
(Contract NASw-563)
(NASA-CR-56831; MH-MPG-1541-TR-2) OTS: $1.60 ph

Problems of control of plants modeled by differential equations containing derivatives of the control (or forcing) functions are discussed. These right side plant dynamics in conjunction with relay-type jumps in the forcing functions require an analysis or synthesis method to accommodate derivatives of step functions. Previously this problem has been avoided formally by transforming to a special set of coordinates in which only zero-order forcing terms appear. This paper develops a mathematical model for equations with derivatives of the control functions and establishes conditions under which the formal transformation can be rigorously applied. Author

N64-25598 Enen Knight Corp., East Natick, Mass.
OXYGEN HORIZON SEEKER, THEORETICAL ANALYSIS Scientific Report No. 1
A. E. Lilley et al 14 Feb. 1964 54 p ref
(Contract AF 19(628)-3239)
(AFCRL-64-141; AD-600783)

This report is a theoretical analysis dealing with the physics of using the oxygen horizon for vertical sensing. The data resulting from this analysis deal with the profile of the oxygen horizon as seen by an orbiting vehicle. Limb brightening and angular slope of the oxygen mantle are described in detail, and the effects of varying limb temperatures and their result on vertical sensing accuracies are included in this report. The system parameters that would be required to perform vertical sensing experiments and have resulted from this theoretical analysis are also included. Results and conclusions are presented to substantiate the feasibility of this experiment. Author

N64-25606 France. Office National d'Etudes et de Recherches Aeronautiques, Chatillon-sous-Bagneux
CONTRIBUTION TO THE STUDY OF ROCKET NOISE [CONTRIBUTION A L'ETUDE DU BRUIT DES FUSEES]
Michel Kobrynski: Apr. 1964 29 p refs In FRENCH; ENGLISH Summary
(ONERA-TN-74)

The sound level of the jet represented by iso-pressure lines, is defined by the acoustic power generated, the generalized spectrum of the acoustic power, and the directional index. The acoustical study of the combustion instabilities of solid propellants consists of determining the unsteady frequencies emitted in the cavities of the grain. The vibratory regime observed is identified by comparing the measured frequencies to the theoretical frequencies of the various modes in these cavities. Only the tangential mode (rotations of the nodal lines in the cavities) is observed. Author

N64-25708* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STATISTICAL TECHNIQUES FOR DESCRIBING LOCALIZED VIBRATORY ENVIRONMENTS OF ROCKET VEHICLES
Robert E. Barrett Washington, NASA 64 p refs
(NASA-TN-D-2158) OTS: $1.75

The Saturn I Block I booster was divided into seven environmental regions and each region further subdivided into structure of essentially similar dynamic characteristics. The vibration measurements representing the response of the basic structure (data acquired from component response were not included) were statistically evaluated resulting in probability estimates on a spectral basis. Factors such as different types of structure, acoustic shadowing effects due to the one-way exhaust deflector, liquid and nonliquid loading, pressurized and unpressurized tankage are all treated. Thus statistical spectra are developed that will describe a variety of diverse cases. With these results discrete and random design and test requirements may be specified with statistical certainty for each particular location and structural type. Author

N64-25776 Lockheed-California Co., Burbank
A STUDY OF AN ORBITAL MAINTENANCE AND MATERIAL TRANSFER SHUTTLE
Ray Goodall et al Wright-Patterson AFB, Ohio, Res. and Technol. Div., Mar. 1964 360 p refs
(Contract AF 33(657)-10290)
(RTD-TDR-63-4057; AD-438517)

A conceptual study of an orbital maintenance and material transfer shuttle is presented. The shuttle is a one-man vehicle used for transporting personnel and materials between other orbiting vehicles and for performing maintenance and repair on space stations or unmanned satellites. The application of the shuttle to existing and proposed space systems is examined and found to be feasible and economically advantageous. The trade-offs between range, duration, propulsion and on-board power systems are presented and design values selected. A simple guidance technique using a short-range radar is formulated. Results of simulated maintenance experiments conducted with a worker in a pressure suit are reported and integrated into the shuttle design. A preliminary design of the vehicle with definitive weights and subsystem characteristics is presented. Author

N64-25796 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium)
A POSSIBLE COMPROMISE BETWEEN ROCKET AND ATMOSPHERIC BRAKING
L. Moulin Jun. 1964 42 p refs
(Grant AF-EOAR-63-39)
(VKI-TN-17; AD-602391)

An attempt was made to optimize the problem of recovering an interplanetary vehicle through the earth's atmosphere. Optimum conditions are defined as the ones that would minimize the dead weight, including the fuel required for eventual rocket braking outside the atmosphere, and the mass that is ablated for heat protection during the flight into the atmosphere. When chemical or nuclear propulsion is considered, pure atmospheric braking is always the best solution, but when electrical propulsion can be used, an optimum compromise between partial rocket and atmospheric braking may exist, depending upon the respective qualities of the propulsion system and ablating material. Author

N64-25801* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
SYSTEM CAPABILITIES AND DEVELOPMENT SCHEDULE OF THE DEEP SPACE INSTRUMENTATION FACILITY, 1964-68 (REVISION 1)
24 Apr. 1964 59 p
(Contract NAS7-100)
(NASA-CR-56666; JPL-TM-33-83) OTS: $5.60 ph

The Deep Space Instrumentation Facility (DSIF) is a precision tracking and communications system capable of providing command, control, tracking, and data acquisition from spacecraft designed for deep space exploration. The design philosophy of the DSIF is to provide a precision radio tracking system that measures two angles, radial velocity, and range, and to use this system for two-way communication with spacecraft in an efficient and reliable manner. Discussed are station geometry and coverage, DSIF capabilities, DSIF relationships, design control technique, and characteristics of recording equipment. G.D.B.

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-24962* National Aeronautics and Space Administration, Washington, D.C.
THE ECONOMICS OF LAUNCH VEHICLES
Richard B. Morrison and William F. Bos N. Y., AIAA [1964] 21 p Presented at the 1st AIAA Ann. Meeting, Washington, D.C. 29 Jun.–2 Jul. 1964
(AIAA Paper-64-276) AIAA: $0.50 members, $1.00 nonmembers

For a given mission velocity requirement, the cost of a vehicle in the launched condition is proportional to its gross weight on pad. Present practice in producing vehicles to meet missions in the earth orbit to earth escape class results in vehicle costs of $20.00/lb of gross weight. The cost effectiveness parameter of launch vehicles depends exponentially upon the quotient of the required mission velocity divided by the specific impulse. Vehicle costs are not greatly influenced by the type of propulsion. Large launch vehicles do not produce appreciable cost effectiveness gains. These conclusions may be extrapolated to predict the cost effectiveness of future launch vehicle systems. R.T.K.

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-24237* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
SATURN V LAUNCH VEHICLE DEVELOPMENT PROGRAM
James B. Bramlet N.Y., AIAA [1964] 8 p Presented at the 1st AIAA Ann. Meeting, Washington, 29 Jun.–2 Jul. 1964
(AIAA Paper-64-271) AIAA: $0.50 members, $1.00 nonmembers

This NASA development program is reviewed for milestones and overall view, as of early 1964. Its history is surveyed briefly, and completed phases are described. The program is entering the crucial phase of testing actual launch-vehicle components. Committed schedules are reported to be in no jeopardy, although the situation can change. D.E.W.

N64-24240* National Aeronautics and Space Administration, Washington, D.C.
UNMANNED SPACECRAFT OF THE UNITED STATES
Edgar M. Cortright [1964] 20 p
(NASA-EP-16) GPO: $0.15

The automated unmanned spacecraft of the United States that have been designed and flown, or that are under active development by NASA, are reviewed. The history and typical examples of scientific satellites, applications satellites, and deep-space probes are presented. Ground-test experiences and space-flight operations are discussed, as are advances in spacecraft complexity. Principal features of spacecraft under development are discussed; these spacecraft include the Orbiting Geophysical Observatory, the Orbiting Astronomical Observatory, the Advanced Orbiting Solar Observatory, Nimbus, Pioneer, Mariner Mars, Rangers VI through IX, Surveyor, Lunar Orbiter, and the Biosatellite. M.P.G.

N64-24496 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MANNED SPACE FLIGHTS
Josef Dvorak *In its* To the Near and Distant Universe 16 Jul. 1963 p 185–219 (See N64-24489 17-05)

Problems discussed with respect to manned space flights include the following: (1) hazards to man during space flight; (2) composition of the spacecraft atmosphere; (3) training of astronauts; (4) flight nutrition; (5) the effects of weightlessness and cosmic radiation; and (6) the epidemiological dangers involved in landing on other cosmic bodies. P.V.E.

N64-24594* National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH SERT I SPACECRAFT News Release No. 64–167
14 Jul. 1964 18 p Available from the Scientific and Technical Information Division

The SERT I (Space Electric Rocket Test) spacecraft is spin stabilized and contains two ion thrustor engines of different types—an electron bombardment ion engine, using mercury as a propellant, and a contact ionization thrustor, using cesium for a propellant. The functional operation of the engines, power supplies, instrumentation, thrust detection systems, and Scout launch vehicle are described. D.S.G.

N64-24889 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE, FEBRUARY 1964
[1964] 25 p

The following information is presented: names of the satellites observed; coordinates of the observing stations; date; right ascension; time; declination; altitude; azimuth; and magnitude. R.T.K.

N64-24890 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE PREDICTION SERVICE, MARCH 1964
[1964] 23 p

The following information is presented: (1) names of the satellites observed; (2) coordinates of observing station; (3) date; (4) right ascension; (5) time; (6) declination; (7) altitude; (8) azimuth; and (9) magnitude. R.T.K.

N64-24903* Republic Aviation Corp., Farmingdale, N.Y. Space Systems Div.
DEVELOPMENT APPROACH FOR AN ADVANCED ORBITING SOLAR OBSERVATORY SPACECRAFT
William B. Evans N.Y., AIAA [1964] 12 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Sponsored by NASA)
(AIAA Paper-64-333) AIAA: $0.50 members, $1.00 nonmembers

The following phases in the development of the Advanced Orbiting Solar Observatory Spacecraft (AOSO) are described: (1) orbital mechanics; (2) spacecraft configuration; (3) experiment integration provisions; (4) stabilization and control subsystem and fine sun sensor; (5) communication and data handling subsystem; (6) power-supply subsystem; and (7) thermal vacuum test of the engineering model. R.T.K.

N64-24907 National Aeronautics and Space Administration, Washington, D.C.
A SOLUTION OF THE EULER-LAMBERT EQUATION FOR FLIGHT ORBITS CLOSE TO HOHMANN TYPES [O Reshenii

Uravneniya Eylera-Lamberta dlya Perelet-Nykh Orbit, Blizkikh k Khomanovskim]
M. S. Yarov-Yarovoy Nov. 1963 6 p Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 1, no. 1, Jul. – Aug. 1963 p 51–54
(NASA-TT-F-8561)

A new, rapidly converging expansion of the right-hand part of the Euler–Lambert equation for near-Khomanov flight was derived. The use of this expansion increases the rapidity of the convergence of iterations during its solution for a broad class of flight orbits. G.D.B.

N64-24973 Congress. House. Committee on Science and Astronautics
PROJECT RANGER
Washington, GPO, Jun. 1964 36 p Report of the Subcomm. on NASA Oversight
(88 th Congr., 2d Sess., Comm. Print)

This is a review of Project Ranger, by the House Committee on Science and Astronautics, in terms of the lunar exploration program, the interest of the Committee in the problem, the NASA-JPL relationship, the Ranger spacecraft, description of the Ranger mission, history of the project, conclusions, and recommendations. G.D.B.

N64-24990* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POLAR IONOSHERE BEACON SATELLITE (S-66) Operations Plan 2-63
Mar. 1963 102 p
(NASA-TMX-55009; X-533-63-29) OTS: $9.10 ph

The Polar Ionosphere Beacon Satellite Program, S-66, will make possible a synoptic study of the ionosphere as it varies in time and space. This program is designed to provide information on the spatial and temporal variations for the entire ionosphere. In addition, the S-66 satellite will offer a means of testing a newly devised optical-tracking system by providing an efficient corner-reflector surface for ground-based lasers. The operations plan deals with such areas as responsibilities, organization, project implementation, the space-operations control center, field-stations operations, space communications-center operations, computing-center operations, and data processing. I.v.L.

N64-25013* National Aeronautics and Space Administration, Washington, D.C.
NASA FACTS (B-2-64). TIROS
[1964] 8 p GPO: $0.15

The NASA weather satellite program, which can detect hurricanes in their formative stages and can obtain measurements of infrared radiation, is carried out with TIROS. Two independent television camera systems, capable of separate or simultaneous operation, make up the heart of the TIROS satellite. Up to December 21, 1963, eight TIROS satellites were launched, and all but the first TIROS exceeded the expected lifespan of three to four months. TV pictures from the satellite are flashed on special screens and photographed by 35-mm cameras at ground stations. Meteorologists analyze the photographic data almost immediately. The TIROS technical control center at the Goddard Space Flight Center monitors the operations of the satellite once orbit has been achieved. The center directs the TIROS command and data acquisition network and monitors the spacecraft and the performance of the three TIROS command and data acquisition stations. TIROS is launched by the 90-ft, 57-ton, three-stage Delta booster. I.v.L.

N64-25075* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EXPLORATION OF THE ATMOSPHERE OF VENUS BY A SIMPLE CAPSULE
Rudolf A: Hanel Washington, NASA, Jul. 1964 24 p refs
(NASA-TN-D-1909) OTS: $0.75

The exploration of Venus by probes that penetrate the atmosphere will allow direct measurements of important physical parameters. Early probes must be restricted to a few simple instruments, but if carefully chosen, they will yield a great increase of knowledge. These results will then pave the way for more sophisticated instruments, to be considered as second and third generation. The main target of the early experiments should be the structure and composition of the atmosphere. Accordingly, pressure, temperature, and density will be measured as well as the nitrogen, carbon dioxide, argon, water vapor, and cloud content. Simple methods to determine these parameters are discussed. Author

N64-25107* National Aeronautics and Space Administration, Goodard Space Flight Center, Greenbelt, Md.
LUNAR AND SOLAR PERTURBATIONS ON ARTIFICIAL SATELLITES
Peter Musen *In* AME Math. Soc. Lecture notes prepared in Connection with the Summer Seminar on Space Math., Pt. III 1963 p 595–600 refs (See N64-25102 17-29) OTS: $17.00 ph

The long-range (secular) effects caused by the moon and the sun are of primary importance for establishing the stability of highly eccentric orbits of satellites. At present no complete analytical theory exists that can treat such orbits. A numerical integration procedure is used to obtain information about the stability of the orbit over a long interval of time or about the lifetime of the satellite. A collection of formulas has been obtained and programed for the actual computation of long-range effects in the motion of artificial satellites, minor planets, and comets, using step-by-step integration. R.T.K.

N64-25212 Giannini Controls Corp., Berwyn, Pa. Astromechanics Research Div.
THE EFFECT OF ELASTICITY ON THE STABILITY OF MANNED ROTATING SPACE STATIONS
F. J. Frueh and V. M. Miller May 1964 26 p refs
(Contract AF 49(638)-1015)
(ARD-TR-02-004; AFOSR-64-0991)

This report presents a basic investigation of the effects of structural flexibility of the rotating space station concept in terms of system stability. The results of the analyses were formed into general stability criteria using the fundamental characteristics of the space station system. The criteria show the relationship between applied forces, configuration flexibility, and configuration damping, and are presented in a manner suitable for preliminary analysis of future design concepts. For design values of current space station concepts using spin-up jets and wobble rate damper systems and for the assumptions used in the analyses, the stability criteria indicate that no instability of the flexible modes should be encountered. Author

N64-25292* National Aeronautics and Space Administration, Washington, D.C.
NASA, WESTERN EUROPE SIGN AGREEMENT COVERING SCIENTIFIC SATELLITES News Release No. 64–178
22 Jul. 1964 6 p Available from the Scientific and Technical Information Division

The first joint satellite agreement between the European Space Research Organization (ESRO) and the National Aeronautics and Space Administration was announced by the two agencies. According to NASA, the organizations have signed

a memorandum of understanding for a project involving two scientific satellites. The two satellites bring to 13 the number launched or planned under the program. ESRO is the nine-nation West European group formed to conduct scientific space research utilizing the capabilities of its member countries. Membership includes Belgium, Denmark, France, Federal Republic of Germany, The Netherlands, Spain, Sweden, Switzerland, and the United Kingdom. Austria has observer status. As with all NASA international cooperative projects, each agency will bear the cost of discharging its responsibilities. The scientific results and findings will be made available to the world scientific community. P.V.E.

N64-25297 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
ROCKET RADIOSONDE AN/DMQ-( ) (XE-1) (FOUR-CHANNEL PARALLEL TELEMETRY SONDE)
Albert Ivins Dec. 1963 43 p refs
(USAELRDL-TR-2382; AD-602050)

This report describes the design and construction of Rocket Radiosonde Set AN/DMQ- ( ) (XE-1). This sonde is radically different from other rocket sondes currently in use in that it provides four channels of simultaneous data, and features modular construction. Presently, an ion density sensor, a thermoconductivity pressure sensor, and two temperature sensors are included in this sonde. The ground data readout system is described. Laboratory tests show that this sonde is capable of continuous and reliable operation. It is easily handled in the field and prepared for flight. Four flight tests to date show potential good sonde performance and ground data-handling equipment sufficiency. Author

N64-25459 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A NEW FORM OF EQUATIONS OF SATELLITE MOTION AND ITS APPLICATION TO INVESTIGATING KEPLERIAN-LIKE MOTION
G. E. Kuzmak and Yu. M. Kopnin 28 Apr. 1964 20 p refs
Transl. into ENGLISH from Zh. Vychislitel'noy Mat. i Mat. Fiz. (Moscow), v. 3, no. 4. Jul.–Aug. 1963 p 730–741
(FTD-TT-63-1201/1+2+4; AD-600778)

The position of the center of mass of a satellite, relative to a system of inertial axes connected with the center of the earth, is calculated by using as parameters the pitch of the orbit, the length of the ascending mode, the argument of latitude, and the radial distance. As an example, a case is considered of a perturbing acceleration, less than the force of the acceleration of gravity, being applied to the satellite. P.V.E.

N64-25591 International Business Machines Corp., Cambridge, Mass Cambridge Space Systems Group
SHORT ARC ORBIT DETERMINATION FOR ANNA SATELLITE Final Report
T. P. Rossoni, P. Sconzo, and D. Winfield Mar. 1964 61 p refs
(Contract AF 19(628)-3266)
(AFCRL-64-273; AD-601183)

A differential orbit correction procedure and its application to observations distributed over short arcs of the geodetic satellite ANNA are presented in this report. Also included is an analysis of the accuracy achieved in determining the position and velocity of the satellite. Numerical results were obtained for a short arc application, using highly precise optical observations. These results show the reliability of the procedure and its degree of precision. In particular, a standard deviation of about 3 sec of arc was obtained. This result is consistent with the accuracies in measured spherical coordinates of right ascension and declination. The size of the error ellipsoid in position was also determined, and its largest semiaxis was about 250 ft. A precise position and velocity standard for the calibration of missile-tracking range instruments was the overriding reason for this study. Author

N64-25687 Boeing Co., Seattle, Wash. Aero-Space Div.
MARINER MARS 69 MISSION STUDY
Mar. 1964 110 p refs
(D2-23177)

Mariner Mars 69 mission definition, which is the objective of this study, will be based on a configuration consisting of both a lander and an orbiter. In this report, the Mariner Mars 69 scientific objectives and measurements, mission profile, engineering plan, and management and organization are discussed. R.T.K.

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-24243 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
MEASUREMENTS OF STRESSES IN MACHINERY COMPONENTS
V. F. Yakovlev and I. S. Inyutin 30 Jan. 1964 145 p refs
Transl. into ENGLISH of the book "Izmereniya Napryazheniy Detaley Mashin" Moscow, Gos. Nauchno-Tekhn. Izd. Mashinostr. Lit., 1960 p 1–114
(FTD-TT-63-731/1+2; AD-437115)

This volume considers methods for experimental measurement of stresses within machinery components. The fundamentals of stress measurement by means of baseless wire pickups at internal points in components are set forth. Examples in which a number of problems are solved experimentally under the conditions of linear, two-dimensional, and three-dimensional stressed states with static and dynamic loads are given. Author

N64-24329 New York U., N.Y. Courant Inst. of Mathematical Sciences
BENDING OF RECTANGULAR PLATES WITH FINITE DEFLECTIONS
Frances Bauer, Louis Bauer, William Becker, and Edward L. Reiss Apr. 1964 27 p refs
(Contracts Nonr-285(42); AT(30-1)-1480)
(IMM-NYU-322; AD-600390)

A previously developed iterative procedure is applied to obtain numerical solutions of the von Kármán equations for rectangular plates subjected to a uniform normal pressure. On the simply supported boundary it is assumed that the normal membrane stress and the tangential membrane displacement vanish. Solutions are obtained for a wide range of values of the loading parameter and the aspect ratio. Boundary layers develop both as the loading parameter and the aspect ratio increase. The stresses and deflections are examined and compared with an "asymptotic" solution that can be valid only in the interiors of long plates. A comparison is made with a previously obtained approximate solution by the Ritz method for the square plate. Author

N64-24355 Naval Weapons Lab., Dahlgren, Va.
PLANE STRAIN FRACTURE TOUGHNESS MEASUREMENTS OF SOLID BOOSTER CASE MATERIALS
H. E. Romine *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 185–211 refs (See N64-24351 17-18)

The notched slow-bend test was adapted for determining K_{Ic} values of fracture toughness in plate and welds of high-strength maraging steel being considered for solid booster cases. Propagation of natural cracks could be tested either in the thickness direction or in the plane of the plate, and local toughness evaluations could be made of specific zones in the weld. The bend test was applied to parent metal and welds in two panels of 1/2-in.-thick plate material of 18 Ni (250) maraging steel, vacuum arc remelted and cross rolled. Initiation of fracture from natural cracks in the parent metal was relatively independent of directional effects in the single-aged panel. K_{Ic} values ranged from 73 to 93 ksi $\sqrt{in.}$ in parent metal of both panels. Lower values of fracture toughness were found in the center of the weld, ranging from 46 to 63 ksi $\sqrt{in.}$ Author

N64-24367 Boeing Co., Renton, Wash. Airplane Div.
FRACTURE TOUGHNESS AND STRESS CORROSION TESTING OF HIGH STRENGTH STEELS
Robert A. Davis *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 528–535 (See N64-24351 17-18)
(AF 33(657)-8705)

Stress corrosion and fracture toughness specimen blanks were removed from plate material, heat treated, and machine finished. Specimens were prepared and tested. Results indicate the following: (1) For the 9% and 18% nickel steels and for the low alloy steels, fracture toughness and stress corrosion susceptibility are related. (2) High fracture toughness is correlated with high stress corrosion resistance. (3) Processing variables may be influential in determining fracture properties. D.E.W.

N64-24368 Republic Aviation Corp., Farmingdale, N.Y. Engineering Div.
EVALUATION OF HIGH-STRENGTH LIGHT WEIGHT LAMINATED PRESSURE VESSELS OF LAP JOINT CONSTRUCTION
G. Citrin *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 538–547 Previously Published as WAL-TR-766.2/3-5; see N64-14640 06-34 (See N64-24351 17-18)

Six vessels were built of maraging steel of various thicknesses and subjected to hydroburst testing. Results indicate feasibility of lightweight laminated design but point out difficulties in trying to erase closures that sustained permanent deformation in each test. Other results concern welding methods, sizing procedures, and surface preparation. D.E.W.

N64-24392 J. G. Engineering Research Associates, Baltimore, Md.
COLLAPSE, BUCKLING AND POST FAILURE OF CYLINDRICAL SHELLS
Joshua E. Greenspon Dec. 1963 18 p refs
(Contract DA-36-034-ORD-3081-RD)
(TR-4; AD-429850)

In this report it is demonstrated how simple existing theories can predict whether a shell will fail by buckling or form a collapse hinge and then fail by this collapse mechanism. It is also shown how work-energy analysis can predict the post-failure plastic deflections of the shell once the mode of failure is known. Some comparisons with experimental results are given. Author

N64-24393 Aerospace Corp., El Segundo, Calif.
BENDING DUE TO RING LOADING OF A CYLINDRICAL SHELL WITH AN ELASTIC CORE
John C. Yao 20 May 1963 28 p refs
(Contract AF 04(695)-169)
(TDR-169(3560-30)TN-5; SSD-TDR-63-723; AD-601750)

The problem of a long, thin cylindrical shell with a soft core and subjected to a radial ring load is solved with the use of the Boussinesq–Neuber stress function for the core in conjunction with classical shell theory. Numerical results for stress and displacement fields are given for various values of the cylinder geometry parameters and material constants. Author

N64-24573 Hexcel Products, Inc., Berkeley, Calif. Advanced Structures Group
DEVELOPMENT AND EVALUATION OF A LIGHTWEIGHT ALUMINUM HONEYCOMB CASE Progress Report 3
M. N. Bandak 7 Apr. 1964 37 p
(Contract DA-04-200-AMC-477(A))
(AD-439657)

Work was done in the areas of test-equipment calibration, fabrication of tooling and test equipment, preliminary engineering-drawing release, fabrication and testing of typical construction specimens, fabrication of the prototype case HXL-1-477, and hydrostatic and drop testing of the prototype case. N.E.A.

N64-24631 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STRENGTH OF AERONAUTICAL STRUCTURES Selected Articles
11 Mar. 1963 71 p refs Transl. into ENGLISH from the book "Prochnost' Aviatsionnykh Konstruktsiy" Moscow, Tr., Aviats. Inst. Oborongiz, 1960 p 19–56, 110–132
(FTD-TT-62-1652/1+2+4; AD-400520)

CONTENTS:

1. THE CALCULATION OF CONICAL SHELLS BY THE VARIATIONAL METHOD OF V. Z. VLASOV B. A. Konovalov p 1–42 refs (See N64-24632 17-34)
2. THE EQUATIONS OF AXISYMMETRICAL THREE-LAYER SHELLS WITH A LIGHT FILLER V. F. Karavanov p 43–69 refs (See N64-24633 17-34)

N64-24840* Alabama U., University Bureau of Engineering Research
A STUDY OF THE STABILITY OF REINFORCED CYLINDRICAL AND CONICAL SHELLS SUBJECTED TO VARIOUS TYPES AND COMBINATIONS OF LOADS Final Report, 15 Oct. 1962–14 Jan. 1964
Carl C. Steyer and William K. Rey May 1964 266 p refs
(Contract NAS8-5168)
(NASA-CR-56542) OTS: $17.00 ph

CONTENTS:

1. FORTRAN II COMPUTER PROGRAM FOR THE EVALUATION OF A DONNELL TYPE OF DIFFERENTIAL EQUATION FOR A SIMPLY-SUPPORTED CYLINDRICAL SHELL Thomas D. Easter p A1–A18 (See N64-24841 17-33)
2. FORTRAN II COMPUTER PROGRAM FOR THE EVALUATION OF A DONNELL TYPE OF DIFFERENTIAL EQUATION FOR AN ORTHOTROPIC CIRCULAR CONICAL SHELL Thomas D. Easter, M. Pearson, and Melvin K. Richardson p B1–B96 (See N64-24842 17-33)
3. AN ASYMPTOTIC SOLUTION FOR CONICAL SHELLS OF LINEARLY VARYING THICKNESS Chin Hao Chang p C1–C40 refs (See N64-24843 17-33)

4. LITERATURE SURVEY WITH ABSTRACTS Raymond C. Montgomery p D1–D52 refs (See N64-24844 17-33)
5. THEORETICAL ANALYSIS OF THE STATIC GENERAL INSTABILITY OF AN ORTHOTROPIC CIRCULAR CYLINDER SUBJECTED TO AN AXIAL LOAD, END MOMENT AND UNIFORM RADIAL PRESSURE William S. Viall and Carl C. Steyer p E1–E43 refs (See N64-15537 07-33)

N64-24841* Alabama U., University Bureau of Engineering Research
FORTRAN II COMPUTER PROGRAM FOR THE EVALUATION OF A DONNELL TYPE OF DIFFERENTIAL EQUATION FOR A SIMPLY-SUPPORTED CYLINDRICAL SHELL
Thomas D. Easter *In its* A Study of the Stability of Reinforced Cylindrical and Conical Shells Subjected to Various Types and Combinations of Loads May 1964 p A1–A18 (See N64-24840 17-33) OTS: $17.00 ph

This report presents a FORTRAN II computer program for use with the UNIVAC 80 solid-state computer for obtaining the solution of an equation in a report by Carl C. Steyer and T. A. Carlton, Jr., entitled "A Study of the Stability of Reinforced Cylindrical and Conical Shells Subjected to Various Types and Combinations of Loads—General Instability of an Orthotropic Circular Cylindrical Shell Subjected to a Pressure Combined with an Axial Load Considering Both Clamped and Simply Supported Edge Conditions." G.D.B.

N64-24842* Alabama U., University Bureau of Engineering Research
FORTRAN II COMPUTER PROGRAM FOR THE EVALUATION OF A DONNELL TYPE OF DIFFERENTIAL EQUATION FOR AN ORTHOTROPIC CIRCULAR CONICAL SHELL
Thomas D. Easter, M. Pearson, and Melvin K. Richardson *In its* a Study of the Stability of Reinforced Cylindrical and Conical Shells Subjected to Various Types and Combinations of Loads May 1964 p B1–B96 (See N64-24840 17-33) OTS: $17.00 ph

This report presents a FORTRAN II computer program that is operationally compatible with the FORTRAN processors of the IBM 7090 and UNIVAC SS80 computer to evaluate constants and coefficients for the Donnel-type, eight-order, differential equation in the report, "A Study of the Reinforced Cylindrical and Conical Shells Subjected to Various Types and Combination of Loads," Section III. G.D.B.

N64-24843* Alabama U., University Bureau of Engineering Research
AN ASYMPTOTIC SOLUTION FOR CONICAL SHELLS OF LINEARLY VARYING THICKNESS
Chin Hao Chang *In its* a Study of the Stability of Reinforced Cylindrical and Conical Shells Subjected to Various Types and Combinations of Loads May 1964 p C1–C40 refs (See N64-24840 17-33)
OTS: $17.00 ph

An asymptotic general solution of a segment of an elastic and isotropic truncated conical shell with linearly varying thickness subjected to lateral normal loads is presented. The segment is free from normal force and moment along the two straight edges but arbitrarily supported along the two circular ends. As an example, a solution is given for a segment with one circular end free and the other end fixed. Author

N64-24844* Alabama U., University Bureau of Engineering Research
LITERATURE SURVEY WITH ABSTRACTS
Raymond C. Montgomery *In its* Study of the Stability of Reinforced Cylindrical and Conical Shells Subjected to Various Types and Combinations of Loads May 1964 p D1–D52 refs (See N64-24840 17-33) OTS: $17.00 ph

This bibliography and group of abstracts are concerned with the stability of reinforced cylindrical and conical shells subjected to various types and combinations of loads. G.D.B.

N64-24885 Tokyo U. (Japan) Aeronautical Research Inst.
ON THE SOLUTION OF NONLINEAR SNAP BUCKLING BY THE PROGRESSIVE APPROXIMATION METHOD
Masuji Uemura Mar. 1964 15 p refs
(Rept.-383)

A set of nonlinear differential equations, based on the finite deformation theory in the two-dimensional shells, has been solved by assuming a specified deflection mode because of the difficulty in obtaining their exact solution; however, the particular deflection mode assumed has a great effect on the buckling load, giving considerably higher theoretical values than experimental values. From these circumstances, the progressive approximation method was applied to the snap-buckling problem under uniform pressure of a shallow spherical shell segment having small value of $\alpha = a\beta^2/t$ (a, radius; t, thickness; β^2, angle of opening), and a more precise and reasonable solution could be obtained by means of a comparatively simple mathematical treatment. Much lower initial buckling loads were obtained with the deflection mode, which varied reasonably with the variations of load and deflection, verifying this method. Author

N64-24918 Tokyo U. (Japan) Aeronautical Research Inst.
ON THE FINITE DEFORMATION MODE IN THE NONLINEAR SNAP BUCKLING
Masuji Uemura Mar. 1964 19 p refs
(Rept.-382)

The nonlinear snap buckling problem of curved beams having small curvature due to external pressure, in which it is possible to obtain the exact solution, was taken up as an example to discuss the following questions; (1) whether or not the approximate methods usually used in the analysis of nonlinear elastic problems are proper to define the buckling load; and (2) whether or not an unsymmetrical deflection might give a lower buckling value, as pointed out previously. The comparison of the exact solution with approximate solutions showed that the assumed deflection mode has a great influence on the buckling load. Further, the analytical result that the buckling loads obtained in the unsymmetrical mode are lower than those in symmetrical modes is found to be true only within the degree of precision of the approximate solutions themselves. The reason is that the symmetrical deflection mode derived from the exact solution of the nonlinear equation gives the minimum buckling load. Author

N64-24927 Aeronautical Research Council (Gt. Brit.)
LIMIT ANALYSIS OF CIRCULAR FRAMES Current Papers
E. O. Imegwu London, HMSO, 1964 23 p refs
(ARC-CP-705; Supersedes ARC-23293) HMSO: 4s 6d

A method of limit analysis is given for aircraft fuselage frames subjected to known distributions of shear flow and vertical load. It is assumed that both axial force and bending moment are significant in causing collapse. An approximate method is adopted in most of the work, but an accurate solution is illustrated for completeness. Author

N64-24995* Southwest Research Inst., San Antonio, Tex.
THE NORMAL MODES OF VIBRATION OF CERTAIN NONLINEAR CONTINUOUS SYSTEMS
Thein Wah [1963] 2 p refs
(Contract NASr-94(05))

Two examples from structural theory are invoked to show that normal modes of vibration could have a simple interpretation in nonlinear distributed parameter systems. Author

N64-24999 Midwest Research Inst., Kansas City, Mo.
RESEARCH ON PANEL FLUTTER
D. R. Kobett Washington, NASA, Jul. 1964 75 p refs Previously Published as NASA-TN-D-2227; See N64-10400 01-33 (Contract NASr-63(05))
(NASA-CR-80; NASA-TN-D-2227)

A computer program was developed that is particularly well suited for use in parametric flutter investigations where a large quantity of numerical data are required. The underlying analysis used exact, linearized, three-dimensional aerodynamic theory so the program can be used to investigate the critical low supersonic regime. Finite panel arrays can be treated, and wind-tunnel installations can be simulated. A limited quantity of informative numerical data are presented. Most of the data pertain to the flutter of single panels with free side edges, with and without adjacent vertical side walls. Author

N64-25018 Army Materials Research Agency, Watertown, Mass.
MEMBRANE NATURAL FREQUENCIES FOR AXISYMMETRIC VIBRATION OF DEEP SPHERICAL CAPS
Edward W. Ross, Jr. Dec. 1963 38 p refs
(AMRA-TR-63-23; AD-428442)

This paper contains the results of an analysis of the natural frequencies for the axially symmetric vibration of a thin shell in the form of a segment of a sphere with a free edge. In the present analysis, only the membrane theory is used, i.e., bending effects are neglected. The effects of both the longitudinal (in-surface) and transverse (perpendicular-to-the-surface) inertias are retained, and the entire range of opening angles is considered. The main body of the results is obtained by numerical solution of the frequency equation although a number of limiting cases (high frequencies, shallow shells, and shells with small holes) are treated analytically. Author

N64-25055* National Aeronautics and Space Administration, Washington, D.C.
APPLICATION OF THE METHOD OF PHOTOELASTIC COATINGS TO THE DETERMINATION OF THE STRESSES AND DEFORMATIONS IN FLEXIBLE PLATES AND SHELLS [PRIMENENIYE METODA FOTOUPRUGIKH POKRYTIY DYLA OPREDELENIYA NAPRYAZHENIY I DEFORMATSIY V GIBKIKH PLITAKH I OBOLOCHKAKH]
M. Kh. Akhmetzyanov Jul. 1964 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr. (USSR), no. 1, 1964 p 199–201
(NASA-TT-F-220) OTS: $0.50

This paper is concerned with a method of investigating plates and shells by means of photoelastic coatings. The problem of determining the stresses and deformations in eleastic flexible plates and shells on the basis of a polarization-optical investigation of such coatings can be solved sufficiently simply and completely, using the mathematical apparatus of the plane problem for separating the stresses. Certain special features of the investigation of the elastoplastic equilibrium of these elements are considered. Author

N64-25066 Aeronautical Research Council (Gt. Brit.)
CRACK PROPAGATION PROPERTIES OF THIN SHEET—SOME RECENT RESULTS AND THEIR IMPACT ON DESIGN
D. Williams London, HMSO, 1961 23 p refs
(ARC-CP-564; Previously Issued as RAE-TN-STRUCT-289, ARC-22470) HMSO: 3 s 6 d

The concept of scale effect to account for dissimilar critical crack lengths in similar flat sheets is placed in better perspective by relating it to Griffith's work on crack propagation. The results of recent experiments are quoted and confirm the reliability of the approach via scale effect and also confirm the semiempirical formula for relating critical stresses in flat sheets to those in corresponding cylinders. Author

N64-25121 David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.
HYDROSTATIC PRESSURE TEST OF A RING-STIFFENED CYLINDER OF OVAL CROSS SECTION (MAJOR-TO-MINOR AXIS RATIO OF 1.5)
William P. Couch Mar. 1964 36 p refs
(DTMB-1788; AD-439208)

Test results of a ring-stiffened oval cylinder indicate that the use of the local radius of curvature and dimensions of the oval cylinder in a solution for a ring-stiffened circular cylinder will not yield good predictions for the deformations and stresses. Based on the collapse strength of the models tested, it appears that an oval cylinder designed for deep-depth operation is a very inefficient structure compared to a circular ring-stiffened cylinder of the same weight-displacement ratio. Test results are compared with results obtained from a theoretical solution recently developed for a ring-reinforced oval cylinder. The theory treats the case of a shell with uniform thickness; the model, however, was composed of two different shell thicknesses. The theoretical results obtained by using the local shell thickness of the test cylinder in the computation showed good agreement with test results for all circumferential stresses and for axial bending stresses; the lack of agreement for the axial membrane stresses is attributed to using the local shell thickness in the calculations from a theory based on constant thickness. The critical stresses were much higher for the ring-stiffened oval cylinder tested than for those of an equivalent circular cylinder based on the same radius of curvature. Tubes or struts placed parallel to the minor axis of the oval cross section appreciably reduced the magnitude of the critical stresses. Author

N64-25173* National Aeronautics and Space Administration, Washington, D.C.
THE EQUATIONS OF THE AXIALLY SYMMETRIC VIBRATIONS OF A LIQUID-FILLED CYLINDRICAL SHELL [OB URAVNENIYAKH OSESIMMETRICHNYKH KOLEBANIY TSILINDRICHESKOY OBOLOCHKI s ZHIDKIN ZAPOLNENIYEM]
V. P. Shmakov Jul. 1964 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr. (Moscow) no. 1, 1964 p 170–173
(NASA-TT-F-219) OTS: $0.50

A thin-walled cylindrical shell with the longitudinal axis oriented in the direction of the field of the mass forces is considered. At the lower end of the shell there is an elastic diaphragm having the shape of a flat spherical segment and serving as a bottom to contain the liquid filling part of the interior space of the shell (it is assumed that the angle between a plane tangential to the diaphragm and a plane perpendicular to the shell axis is small. Author

N64-25179* National Aeronautics and Space Administration, Washington, D.C.
THE EQUATIONS OF THE TRANSVERSE VIBRATIONS OF LIQUID-FILLED SHELLS [OB URAVNENIYAKH POPERECHNYKH KOLEBANIY OBOLOCHEK s ZHIDKIM ZAPOLNENIYEM]

B. I. Rabinovich Jul. 1964 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr. (Moscow), no. 1, 1964 p 166–169
(NASA-TT-F-16) OTS: $0.50

The transverse vibrations of a thin-walled cylindrical shell of circular cross section, entirely or partially filled with an ideal incompressible liquid, are examined within the framework of the Vlasov theory. A formula is presented for the displacement potential satisfying the boundary conditions for the case of an arbitrary depth of liquid. Author

N64-25194 Aeronautical Research Inst. of Sweden, Stockholm
DETERMINATION OF CRACK LENGTHS BY IMPEDANCE MEASUREMENT
Janne Carlsson 24 Aug. 1962 36 p refs
(FFA-HE-988)

A method for measuring cracks by means of impedance measurement has been developed and applied for measuring propagation speed of brittle cracks and fatigue cracks. An account of the general principles of the method is presented. A report is given on arrangements with high-frequency alternating current and on the results from measurements of brittle cracks in brass and of fatigue cracks in aluminum sheet material. Author

N64-25202 Aeronautical Research Council (Gt. Brit.)
THE ESTIMATION OF STRESSES AROUND UNREINFORCED HOLES IN INFINITE ELASTIC SHEETS
A. J. Sobey London, HMSO, 1964 21 p refs
(ARC-R&M-3354; Supersedes RAE-Struct-283; ARC-24479)
HMSO: 8s

A practical procedure for the investigation of the state of stress around an arbitrary doubly symmetric hole in infinite elastic sheets in tension and shear is presented. The associated problem of conformally mapping an arbitrary region onto the unit circle is solved using an iterative technique. Author

N64-25219 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
COMPLETE DETERMINATION OF THE PLANAR STRESS CONDITION BY THE AXIAL PATTERN METHOD
R. Hiltscher 8 May 1964 16 p refs Transl. into ENGLISH from Forsch. Gebiete Ingenieurw. (Germany), v. 15, no. 1, 1944 p 12–17
(RSIC-180; AD-602062)

A quantitative assessment of the planar stress condition at a point in the model was accomplished by selecting the sections under stress in a reinforced concrete structure. An accurate point-by-point measurement of the planar stress condition is given according to magnitude and direction of the principal normal stresses and the maximum shearing stress. The method is based solely on the gaging of isochromatic fringe patterns, which are obtained by means of simple equipment. The strong point of the new method of analysis is that it is especially applicable to those places in the model that exhibit few isochromatic fringes—a low shearing stress gradient. G.D.B.

N64-25223 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
PURELY OPTICAL METHOD FOR DETERMINING INTERNAL STRESSES OCCURRING IN STRUCTURES
Henry Favre 15 Jun. 1964 17 p refs Transl. into ENGLISH from Schweiz. Bauz. (Zurich), v. 90, no. 23, Dec. 1927 p 291–294
(RSIC-189; AD-602058)

Two basic relations regarding induced birefringence of transparent flat plates, subjected to two-dimensional action from stresses, are proved in two different ways: (1) δ_1, the difference in path between the new beam, vibrating parallel to the vertical vibration (one of two well-defined orthogonal directions) after the application of forces, and the original beam, vibrating parallel to the direction of the vibration of the beam before the application of forces; and (2) δ_2, the difference in path between the new beam, vibrating parallel to the horizontal vibration (the second of the two well-defined orthogonal directions) after the application of forces, and the original beam, vibrating parallel to the direction of the vibration of the beam before the application of forces. I.v.L.

N64-25224 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
PHOTOELASTICITY: APPLICATIONS AND METHODS
G. Delanghe 9 Jun. 1964 27 p refs Transl. into ENGLISH from Le Genie Civil (France), v. 91 10 Sep. 1927 p 243–249
(RSIC-191; AD-602059)

The photoelastic method rests essentially on the use of polarized light for the examination of a model, constructed of a homogeneous transparent substance, and reproduces the elastic system of the object of study. The method is based on David Brewster's discovery that isotropic transparent solids, which are singly refracting in the natural state, become doubly refracting when they are subjected to elastic deformations. This birefringence, which lasts as long as the deformation, obeys very simple laws that permit not only qualitative observations, but precise measurement of elastic fatigues. Areas of application include the following: (1) verification of the hypotheses admissible in the theory of the strength of materials;(2) the study of an arched-beam bridge; (3) the study of a concrete foundation wall; (4) the study of an internally hyperstatic cantilever beam; (5) the determination of the distribution of internal stresses in a tensile-test piece; (6) the influence of slots on the distribution of internal forces; (7) the influence of holes on the distribution of internal forces; (8) the distribution of the tensions at the point of contact of a shaft (bolt or rivet) with the plate through which it passes; and (9) the rational designing of machine parts. Also, the elements of the optics employed are reviewed. I.v.L.

N64-25284* Consultants and Designers, Inc., Arlington, Va.
SEMIMOMENTLESS THEORY OF CYLINDRICAL LAMINAR SHELLS [POLUBEZMOMENTNAYA TEORIYA TSILINDRICHESKIKH PLASTICHNYKH OBOLOCHEK]
M. Sh. Mikeladze May 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 154, no. 2, 1964 p 298–299
(Contract NAS5-2078)
(NASA-TT-F-8900; ST-TE-10142)

A semimotionless theory of a cylindrical laminar shell is proposed. It is assumed that an orthotropic shell is subject to the action of assigned forces. The unknown thickness (h) of the shell is selected in such a way that stresses at each point of the construction correlate with the condition of yield. Neglecting the influence of the longitudinal bending and torsional moments (M_1 and M_{12}) on the strained condition of the shell, the condition of yield, expressed through stresses and moments takes the form $GH + HF + FG/(H + F)h^2 T_1^2 + 2N/h^2 T_{12}^2 + 16(H + F)/h^4 M_2^2 = 1$, where T_1 is the normal longitudinal stress acting along the cylinders' generatrix, T_{12} is the shearing force, and M_2 is the cross-sectional bending momentum. The coefficients G, H, F, and N, are known constants, characterizing the plastic properties of the shell's material in various directions. It is assumed that, relative to the

main anisotropy axes, they coincide with the directions of the generatrix, tangent to the arc of the contour line and to the internal normal. The normal cross-sectional stress (T_2), which does not figure in the formula, is proportional to the stress (T_1). I.v.L.

N64-25336 IIT Research Inst., Chicago, Ill. Technology Center
ANALYSIS OF FRACTURE PROBABILITIES IN NON-UNIFORMLY STRESSED BRITTLE MATERIALS
N. A. Weil and I. M. Daniel [1963] 33 p refs
(Contract AF 33(616)-7465)
(AD-437664)

This paper describes the results of theoretical studies on the effect of nonuniform stress fields limited to those encountered in prismatic beams under bending, upon the fracture of brittle materials. Derivations were carried out to determine the risk of rupture of bending specimens subjected to a symmetrical four-point load of arbitrary spacing, the symmetric three-point loading and pure bending forming limiting cases of this more general loading. The analysis was based on materials obeying the Weibull distribution function with assumptions for either volumetric or surface flaw dispersion conditions. Comparisons are presented between the predicted strengths of bending and tensile specimens. An analytical method for the determination of the three Weibull parameters from a pure bending test is proposed. This method, based on the best fit of a theoretical curve to the experimental data, was successfully applied to experimental results on Columbia Resin, a brittle amorphous polymer. Author

N64-25398 New York U, N.Y. Courant Inst. of Mathematical Sciences
BIFURCATION BUCKLING OF SPHERICAL CAPS
Edward L. Reiss Apr. 1964 38 p refs
(Contract Nonr-285(42); Grant DA-ARO-(D)-31-124-G344)
(IMM-NYU-324; AROD-3069-5; AD-601176)

A nonlinear boundary value problem is considered for the axisymmetric buckling of thin spherical shells subjected to uniform external pressure. The uniformly compressed spherical state is a solution of this problem for all values of the pressure. It is proven, using Poincaré's method, that for pressures sufficiently near each simple eigenvalue of the linearized shell buckling theory, there is another (buckled) solution of the nonlinear problem. A convergent perturbation expansion is used to analyze the buckled solutions near the eigenvalues. For a limited range of caps, it is also proven that one or three buckled solutions bifurcate from the multiple (double) eigenvalues, depending on their order. The existence of a lowest intermediate buckling is established, and precise upper and lower bounds are given on its magnitude. Author

N64-25443 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
STRUCTURAL DAMPING IN PERMANENT JOINTS
N. G. Kalinin, Yu. A. Lebedev et al 1 May 1964 201 p refs
Transl. into ENGLISH from the book "Konstruktsionnoye Dempfirovaniye v Nepodvizhnykh Soyedineniyakh" Riga, Izd. Akad. Nauk Latv. SSR, 1960 p 3-169
(FTD-TT-63-755/1+2; AD-601544)

A series of static problems, particularly the operation of elastic-frictional systems, were solved. The simplified concepts about the nature of dry friction forces made it possible to assume that energy dissipation attendant to vibrations is independent of the process rate. In the problems with relatively weak damping, energy dissipation plays a noticeable role only in the immediate proximity of resonance. The complex problem of the form of forced vibrations of systems with several degrees of freedom for arbitrary periodic disturbances becomes relatively simple. G.D.B.

N64-25553 Aeronautical Research Council (Gt. Brit.)
ON THE VIBRATIONS OF CYLINDRICALLY CURVED ELASTIC SANDWICH PLATES. PART I — WITH THE SOLUTION FOR FLAT PLATES. PART II — THE SOLUTION FOR CYLINDRICAL PLATES
D. J. Mead and A. J. Pretlove London, HMSO, 1964 55 p refs
(ARC-R&M-3363: Supersedes AASU-186, -187, ARC-23942, 23943) HMSO: 1 £ 1s

Consideration of the equilibrium of the anisotropic core of a cylindrically curved sandwich plate leads to the three simultaneous differential equations for the three orthogonal deformations. Boundary conditions on two sides are found by considering the equilibrium at the core–face-plate interface. A separable solution leads to the two sets (symmetric and antisymmetric) of three homogeneous equations for the flat sandwich plate with a honeycomb core. These two sets lead to nondimensional determinantal frequency equations for the flexural and bubbling modes. The calculation of mode shapes is indicated, and the nondimensional frequency is plotted against other variables for all likely aircraft panel configurations. A solution is found for curved sandwich plates by assuming that a flat-plate core solution bounded by curved-plate edge conditions holds true. An indication, though not a proof, of the validity of this assumption is given. A determinantal frequency equation is thus found for curved plates, and an expected anomalous frequency variation with circumferential wavelength becomes evident. The variation of frequency with wavelength for bubbling modes is only very slight for both flat and curved plates. Author

N64-25584 Massachusetts Inst. of Tech., Cambridge School of Engineering
NONLINEAR DYNAMIC RESPONSE OF REINFORCED CONCRETE CIRCULAR ARCHES
Indravaoan K. Shah Jan. 1964 108 p refs
(Contract NBy-32227)
(R-64-6; AD-602045)

A method is developed for predicting the response and the ultimate load carrying capacity of reinforced concrete circular arches under dynamic loading. The arch may be hinged or clamped at the ends. A set of differential equations and boundary conditions governing the behavior of reinforced concrete arches under dynamic loading is formulated. These equations are derived by considering the arch element in its deformed state. The force–strain relations are formulated by assuming a nonlinear stress–strain curve for concrete and a bilinear stress–strain curve for steel. The governing differential equations are converted into difference equations that, together with the force–strain relations, are solved by a step-by-step method of numerical integration. Author

N64-25749 Massachusetts Inst. of Tech., Cambridge School of Engineering
TECHNIQUES AND MATERIALS IN THE MODELING OF REINFORCED CONCRETE STRUCTURES UNDER DYNAMIC LOADS
Harry G. Harris, Peter C. Schwindt, Imad Taher, and Stuart Werner Dec. 1963 168 p refs
(Contract NBy-32228)
(R63-54; DSR-9384; AD-602036)

A study was made of the technological problems involved in the materials choice, fabricating techniques, and loading

requirements of models of reinforced structures subjected to dynamic loading effects. The overall problem of reinforced microconcrete models is examined from the point of view of clarifying the basis of model scale, aggregate gradation, size of test specimen, and fabricating techniques used for structural models. The bond characteristics of a wide range of reinforcing wires was investigated in specimens designed to place the microconcrete in a tension zone. An investigation of the effect of strain rate on the ultimate strength of microconcrete for 2- × 4-in. cylinders showed an increase in the unconfined compressive strength with an increase in strain rate. The use of various filler epoxy systems to model concrete was investigated. A dynamic loading system suitable for model studies was also investigated. R.T.K.

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-24354 Aerojet-General Corp., Sacramento, Calif. Propulsion R and D Div.

EVALUATION OF HIGH NICKEL MARAGING STEEL FOR APPLICATION IN LARGE BOOSTER MOTOR FABRICATION

P. P. Crimmins *In* AFSC Third Maraging Steel Proj. Rev. Nov. 1963 p 95–183 (See N64-24351 17-18) (Contract AF 33(657)-8740)

Results are presented of tensile tests conducted to determine aging response of seven heats of 1/2-in.-thick, 18% nickel, maraging steel plate material. Limited studies were conducted, and data are given for evaluation of tensile properties of 225- and 300-ksi, 4-in.^{2} bar stock. Conclusions are that wide variations in strength levels can be attained in the 18% nickel maraging steel alloys and that yield strength of (ksi) = 15.1 + 9.1 (%Co) + 28.3 (%Mo) + 80.1 (%Ti) can be attained. Metallurgical microstructural studies of plate and bar materials, and their results, are given. Fracture toughness was evaluated for 18%-nickel maraging steel by slow notch bend testing, partial-thickness crack testing, center notch tensile testing, and precracked impact testing. The TIG welding process, the submerged arc welding process, and the metal-arc inert-gas welding process were carried out on 18%-nickel maraging steel, and welded joints were submitted to chemical analysis, tensile tests, and metallurgical examination, the results of which are presented. D.E.W.

N64-24579 Joint Publications Research Service, Washington, D.C.

MARINE SOUNDPROOFING PROBLEMS

28 May 1964 25 p refs Transl. into ENGLISH of two Articles from Sudostroyeniye (Leningrad), no. 3–4, 1963 (JPRS-24818; OTS-64-31357) OTS: $0.75

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N64-24580 Joint Publications Research Service, Washington, D.C.

INVESTIGATION OF NOISE ON A DIESEL SHIP WITH HYDROFOILS

V. I. Zinchenko, A. G. Yel'nik, and E. I. Avferonok *In its* Marine Soundproofing Problems 28 May 1964 p 1–12 (See N64-24579 17-34) OTS: $0.75

The following areas were investigated in order to determine the main sources and means of propagation of structural and air noise on a diesel ship with hydrofoils: (1) evaluation of the sound-absorbing properties of ship construction; (2) sound insulation of hull construction; (3) measurement of air noise; (4) measurement of vibration of the vessel hull; and (5) measurement of vibration in the machine room. In an effort to lower the noise, the following are recommended: (1) installation of deck structures and quarters of the "floating" type; (2) covering the hull in the compartments over the foils and shaft containers, the decks in salons, and the partitions of compartments with vibration-damping materials effective over a wide range of frequencies; (3) insulating, as much as possible, the thrust bearings, shaft containers, and foil structures, from vibration from the hull; (4) strengthening the soundproofing of the deck between the machine room and the deckhouse, and, especially, soundproofing the hatch; and (5) strengthening the vibration proofing of the exhaust channel of the main engines, for which it is necessary to replace the rigid brackets and to fasten the exhaust pipelines and mufflers with spring dampers. J.L.D.

N64-24581 Joint Publications Research Service, Washington, D.C.

SOUNDPROOFABILITY OF SHIP HULL CONSTRUCTIONS

I. I. Bogolepov *In its* Marine Soundproofing Problems 28 May 1964 p 13–22 refs (See N64-24579 17-34) OTS: $0.75

The relation of the soundproofing ability of ship coverings to all basic parameters—mass, rigidity, internal friction, etc.—is examined. In designing ship-hull constructions, the minimum soundproofing ability is found in the region of the critical frequency. To increase the capability in this region of frequencies, the following methods were implemented: (1) By changing the thickness of material of the plate—cutting the plate thickness in half, and consequently reducing its weight—the capability can be increased by 3 to 8 db in the region of frequencies where there was minimum soundproofing ability. (2) A large number of edges of rigidity or an edge of rigidity with a large moment of inertia will be particulary advantageous below the critical frequency. J.L.D.

N64-24632 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE CALCULATION OF CONICAL SHELLS BY THE VARIATIONAL METHOD OF V. S. VLASOV

B. A. Konovalov *In its* Strength of Aeron. Struct. 11 Mar. 1963 p 1–42 refs (See N64-24631 17-33)

A system of differential equations is derived for calculating the dimensions of a slightly conical shell of constant thickness. Allowance is made for deformation of the contour. On the basis of the results obtained, more accurate solutions for the specific cases of bending and torsion of a simply closed conical shell are constructed. R.T.K.

N64-24633 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

THE EQUATIONS OF AXISYMMETRICAL THREE-LAYER SHELLS WITH A LIGHT FILLER

J. F. Karavanov *In its* Strength of Aeron. Struct. 11 Mar. 1963 p 43–69 refs (See N64-24631 17-33)

The following are discussed: (1) the geometry of an axisymmetrical three-layer shell; (2) equilibrium of the supporting layers; (3) distribution of the stress in the filler layer; (4) equilibrium of a composite shell; (5) the potential energy of deformation of the shell; (6) relationships between the stresses, moments, and displacements in the case of a composite shell; (7) reduction of the system of equations to two simultaneous equations; and (8) the equations for axisymmetrical three-layer shells, without allowance for transverse compressive deformation of the filler. R.T.K.

N64-24960 Southampton U. (Gt. Brit.) Inst. of Sound and Vibration Research

NOISE PROBLEMS ASSOCIATED WITH SUPERSONIC FLIGHT WITH EMPHASIS ON STRUCTURAL ASPECTS OF THE PROBLEM Fourth Theodore Von Karman Lecture of the Israel Society of Aeronautical Sciences

E. J. Richards Feb. 1964 16 p refs Presented at the 6th Ann. Conf. on Aviation and Astronautics, Tel-Aviv, Israel, 24–25 Feb. 1964

(Sponsored by Israel Airlines El-Al and Technion)

The purpose of this paper is to draw attention to problems of noise from supersonic airliners, as they affect operators of aircraft and airports, as well as designers. It is convenient to separate noise as it affects passengers from noise as it affects the airplane. Takeoff noise, landing noise, sonic booms, noise inside aircraft, effects of noise on structure, and other noise-induced problems are discussed. G.D.B.

N64-25479 Aeronautical Research Council (Gt. Brit.)

ON THE DESIGN OF A ROW OF WINDOWS IN A PRESSURIZED CYLINDRICAL FUSELAGE

E. H. Mansfield London, HMSO, May 1963 11 p refs (ARC-R&M-3360; supersedes RAE-STRUCT-287, ARC-24824) HMSO: 5s

Some factors affecting the design of a row of windows in a pressurized cylindrical fuselage are discussed. The concept of the neutral hole is adopted, but account is taken of the change in the basic 2:1 stress field occasioned by the presence of stringers, frames, longerons and, in particular, reinforced strips surrounding the windows and running the length of the fuselage. The influence of such reinforcement is to make the shape of the neutral hole slightly more circular than the standard $\sqrt{2}$:1 ellipse. Results are presented in graphical form. Author

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